REFLEXIVE PROCESSES AND CONTROL

International Interdisciplinary Scientific and Practical Journal

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FROM THE EDITOR

The September 11 attack is not just a barbaric act that took away thousands of human lives; it can also be viewed as a strategical challenge to mankind, a test of maturity of nations and peoples and their ability to solve the most complicated social problems using democratic means. But the humanity has not rallied for a quest of optimal ways of development, instead, it finds itself on the brink of severe global conflicts.

Various destructive forces supporting terrorism appeal to collective values of religious and cultural nature and skillfully exploit them. Simultaneously, the widespread individualism, egocentrism, and rationalistic approach bring to the foreground economic interests of the world community leaders screened only by anti-terrorist verbosity. The role of democratic institutions is being played down. The real causes of terrorism are being substituted with imaginary ones. The importance of moral and cross-cultural aspects in solving strategic human problems is downgraded.

Thus, the task of intensive research of reflexive processes is becoming urgent and the efforts of completing it acquire the moral meaning. The explorers of reflection do not disregard this problem and work hard to make their recommendations socially significant and morally convincing. To illustrate their efforts, we reproduce in this issue some excerpts from a monograph by Professor O.A. Anisimov (Russian Academy of State Service). The author imitates a hypothetical dialogue with the President on strategic decisionmaking to determine future development of Russia. The main message carried by the monograph is that the organizing of decision-making processes requires the use of reflexive studies.

V.A. Lefebvre (USA) investigates the problems of ethics and examines cross-cultural difficulties in international relations as they appear in Russian-American relationships. The Editorial Board of our journal assisted in publishing Lefebvre's monograph "Algebra of Conscience" in Russian.

A.G. Zadokhine, in his paper, points out that the biggest subjects of the world politics cannot afford "the luxury of misunderstanding" and mutual rejection of differing ethical systems.

A.Rappoport (Canada) has devoted his article to general philosophical issues.

We have kept the columns of the previous issue and set up a new one – *science of sciences.*

In my article published in the last issue I gave an account on the project which had been addressed to the Russian President and dealt with a possible way to overcome the disorganization in Russia. The leading role was attributed to the strategic elites. Since then the Project (presented in greater detail) has been positively received by some outstanding politicians and leaders of the country. There is a hope that it will be realized.

Vladimir Lepsky

STRATEGIC DECISION-MAKING

DEVELOPMENT OF RUSSIA AND THE WAYS OF STATE POLICY-MAKING

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Introduction

A relative stabilization of political and economic life in Russia makes it possible to think about the large-scale and principal problems of the country's further way of development. Most of deliberations and considerations are concentrated either on nearest opportunities and urgent needs or on wishes derived from the solid ground of real prospects. Only few people take into account the existing situation and search such a path that would make Russia to fit its potentials and its great power status. A question arises: what kind of potentials should be relied upon for qualitative and quantitative changes of the current situation?

The peculiarity of the former USSR and Russia is that in spite of bad organization of businesses (including innovative activities), the volume and quality of the results and manifestations of intellect remain huge. This fact was taken into consideration by both our allies, and our adversaries. Russian intellectual activity is skillfully used today in forms that make exploitation possible and result in engaging authors into projects which do not bting commeasurable benefits to Russia. Besides, in Russia a new phenomenon emerged in the intellectual activity within the framework of which the culture of thought has become directly usable. A bright self-expression of intellect aspiring for novelty, for change and development and a special type of culture – the reflexive culture – have become combined within the methodological movement. That makes it possible to sharply increase the productivity of intellectual work and gives birth to new and wonderful opportunities in managerial, analytical and other intellectual-intensive types of activity.

Methodologically organized reflexion is needed in any type of activity, especially in thought-intensive types, for instance, in science, consulting, pedagogical activity etc., and it is obvious that a direct link between manager and methodologist is necessary. Moreover, it is in the decision making - both primary and repetitive – where the though dramas incorporated in the realization of reflexive functions take place. The methodological reflexion forms, dedramatizes or deepens in the course of problematization.

In monitoring the events, participating, though episodically in preparing recommendations for the top leaders of the country and knowing the state of affairs in the field of civil servants training, we imitated a meeting with our "customer". We make the President to play that role. Thus, a model of a path toward creative interaction between "Authority" and a methodological branch of culture took its shape, and a socialization of this still marginal school of thought took place. It is even more so, because it was the methodology that turned Russia into a country of classical thought retaining the heritage of such philosophical thinking periods as "ancient Greek" and "classical German" philosophies. The methodology brought the philosophical thought to the level of technological forms and predetermined the possibility of their use in practice. But a practical use of the philosophers' depth of thought and a demonstration of its potential in the managers' regular work remain so far only a wishful thinking. Nevertheless, the new forms of thought interaction in the game modeling moved that wish to the plane of realization accessible to observation.

The dialogue created as an indirect communion with the President - taking into account our positive attitude to the prototype – acts as a preliminary step toward comprehension of what is going on the country's intellectual culture. Such learning may also serve as a path toward enlightening authority.

The specifics of interaction with the customer is that, inspite of a great intensity of contents, the customer cannot make clear for himself the essence of problems being the source of temporary or long-term "lack of power". The customer waits for an answer to the question that he can put only approximately. The person undertaking the task of answering the question must put it in more clear terms, which is possible only within the framework of experience and use of techniques unfamiliar to the customer. Therefore, the answer often seems to the customer difficult to identify, lacking «normal», that is, usual reasoning or, at best, strange. In order to understand "the answerer", the customer himself either finds his own - in usual forms and ways – explanations (with which the answerer more often than not disagrees), or has to consider, penetrate or master the answerer's reasoning. As those efforts are rarely easy due to the difference in experiences, positions, technologies etc., the evaluation of the answer most often is only approximately adequate. The custom-

er's wisdom lies in a prudent nature of both negative and positive evaluations, as well as in turning to more neutral means and landmarks, the role of which is played by the philosophical vision of the world. Frequently the intuition is of help, giving an opportunity to somehow "feel" the type of contents and its incorporation in an integrated world outlook. In his turn, the answerer also has an opportunity to dress his thought in illustrations helping to find the path toward the main contents. Of course, by Doing that, he does not play a role of a guide who knows answers to all questions.

In the dialogue presented, there is no surface tensions, no opposition of viewpoints or some kind of brilliant struggle of tempers and adherents of one's own version "by all means". The drama is moved into the contents reflecting not only the difference of approaches and views, but also the dependence on those of the broadest possible practice of management. That, which only mentioned and slightly characterized by the methodologist is a gleam of his most difficult and furious discussions with other specialists and methodologists with each other. That is preconditioned by the principal nature of the practical, theoretical and cultural problems discovered in the work of thought. A complete disclosure of their contents lies beyond the framework of communion with the customer who does not possess the experience of similar systematic discussions with selected landmarks unusual to him.

And yet, the dialogue gives and impetus to thoughts and, maybe, to deeper discussions due to the utmost significance of the contents of the problem points and the novelty of their comprehension.

A Fragment of the Hypothetical Dialogue
«Development of Russia and Government Decision-Making Process»

Personas:
P – President
AS – Presidential Assistant on the Security Issues

1. **P.** Let's use a pause between the official events and talk more quietly and freely about the threats to the security of the country. What do you think about the dynamics of its security, if it may be said so?
2. **AS.** You know, it has become somewhat easier with that. Frankly speaking, everything was so entangled and complex, when you were coming to power, that catastrophes one after another seemed to await us.
3. **P.** You mean the economics, the famous default or the Chechen knot?
4. **AS.** Yes, the first, the second, and the third. Just take the uncontrolled freedom of the governors and the presidents of republics. Besides, the confusion within the federal authority. God knows what was going on in the economy. I served and got accustomed to dangers, but even I felt frightened. How many of my colleagues, as well as guys from the army and elsewhere run away, while those remaining became gloomy and misguided. Words are of no use here!!!

5. **P.** I understand. As a former intelligence officer I had to look at the developments with no emotions. As if it was another country. And it's very hard, as I am in fact here in my home and therefore see the same that everyone else sees. Thanks God, I had enough strength to do what I could do. Actually I did not expect to become a President.

6. **AS.** Probably, you didn't want to bear the burden of disgraces accumulated in the country...

7. **P.** On the one hand, that's right; but this is now only a private point of view. On the other hand, have I had the right not to take the responsibility!? I cherish everything around me. Both the Union and Russia, no matter how it is called, is my Motherland. So what: to run like a rat from a ship! Of course, a rapid ascend entails huge inconveniences. It is also easier to solve something within a narrow and pleasant business-like circle. But dangers are dangers. At a certain moment one asks the self : are you ready to go to all lengths for the sake of everything dear to you?

8. **AS.** But there are the so-called «cosmopolites». Their motherland is everywhere, especially in those places where life is easier.

9. **P.** I did not refer to them. No use! I'm talking about those who have always gone to all lengths for the sake of everything that's sacred and dear. About the real man. I used to meet many such people in St. Petersburg. One should know the history in order not to get entangled as a human. But let's return to the subject.

10. **AS.** That's what I say. First it was Daghestan, then the other things. And thus a new situation began emerging.

11. **P.** Daghestan was a threshold point. I communicated later with our military. They are excellent, though, of course, not all of them. They were preparing for the inevitability of the next war. For me, that was already easier. And the civilians were fed up as well. Even the speculator-type democrats and their mass media became quieter. I'll tell you frankly that during the first campaign there was bitterness every day. It was painful to see everything going every wrong way. I understood it was extremely difficult to reach a degree of control and mobilization in that situation in the country.

12. **AS.** And how many there were speculations and cheap slogans, how many traitors nourished with money! And yet I myself was in Chechnya, though not the whole time, and I saw our ordinary boys, privates and officers. You know, they were no less genuine heroes than those in 1941!

13. **P.** I know this and I'll never think I did enough for them. We owe them a lot. The matter is not with those who were bought and ran from the bandits, but with those who were responsible to their conscience. The whole mask-show of freedom-loving was the same bluff for the organizers as the mask-show of Germany's grandeur was for Hitler and his men, even if one were to assume they were frank in the conditions of the first period before 1933, given the state of Germany then. And these «heroes» involved simple people into a very risky affair with no possibility of escape due to both demagogy and vendetta. I understood that then and understand that now. And it seems to me those guys also understood something or everything, at least intuitively. But just to think about the number of victims of that bacchanalia! Well, that a painful spot. The economics is even more important. If it is not restored according to new principles, the possibility of destabilization will always be there, and all heroism will be devaluated. Therefore, we need to build a basis for stability instead of remaining permanent firemen.

14. **AS.** Yes. Let there be the fire service plus some other services like the Ministry for Emergencies. And the most important, the infrastructure of stability must be established. It's good you have significantly strengthened the machinery of the state. Without that it is very difficult and somehow fictitious to think about the economics. It was not for nothing that the Bolsheviks were first weakening the state and then everything could be taken by almost bare hands.

15. **P.** True, but the changes that occurred are more of an operative response nature and just had to be done. That's not a strategy. The strategy is to be elaborated yet.

16. **AS.** There were those who criticized those actions of yours as feverish and populist. Today they still believe that the fruit are no so great and that there is more of disguise and failure in that.

17. **P.** I don't take such criticism seriously. It is 90% useless or even more. It's another matter that I need to be familiar with it: it is possible to find there hints at real failures, unfinished efforts, and lack of skills. I believe it was not a systematic attack at the enemy, but rather actions according to the situation, with some shift to the right direction. And the positive aspect of those actions was the fact that weakening of the arbitrariness of the legislature and the authority and a shift in proportions to favor the Center have created more opportunities for major activities.

18. **AS.** I agree with you.

19. **P.** So, what is, in you opinion, the real danger?

20. **AS.** It's a complicated question. Now at last the West has turned it face to us, and the outrages in Chechnya are on a decline. Of course, difficulties remain everywhere.

21. **P.** I'd put the question as follows: one may see negative things everywhere; one may see dangers in all components of control and planes of existence in the country. But an integrator is needed. An image of the danger to the country as a whole is needed. Do you agree?

22. **AS.** At a first glance it's clear. And I feel that you touch the question in a deeper way. But I cannot comprehend it yet.

23. **P.** Let me put it differently. I asked Mr.Gref to create a strategic picture of the country's development for the period till 2010, including the intermediate stages. Do you think he managed to produce the picture concerning the country as a whole?

24. **AS.** It seems so! All things of importance were depicted there.

25. **P.** And can there be such a prospect wherein the plans for all aspects of life, the major ones, of course, are present, while a plan for the country is absent?

26. **AS.** That is hard to imagine.

27. **P.** But what if you do imagine? If the life strata and amendments to them do not complement each other? If the efforts do not add up?

28. **AS.** I've understood you. As an officer, I see it clearly: there can be no sure strike delivered if all the fighting arms are not combined. Have I understood you right?

29. **P.** Certainly. But in the military field that's done easier. There the mechanisms of control permit to put any units, resources etc close to each other or to take them apart . But everything is more complex in controlling the country. Even more so, as we have just began making market economy, democracy, civil society and so forth. So, can there be danger, in unsuccessful planning, unsuccessful strategic planning?

30. **AS.** Yes. Because of misbalance and lack of combination between all different components.

31. **P.** That's what I think too. Mr.Greff did not guarantee coordination and admitted how difficult it is to achieve it.

32. **AS.** Which is obvious.
33. **P.** It seems to me the problem is that it's difficult to do already in thought and even more difficult in deed.
34. **AS.** Thinking is a complex and sophisticated activity.
35. **P.** And do they, in your opinion, train strategists at the General Staff Academy?
36. **AS.** The situation there is more difficult at present. You know that yourself!
37. **P.** Were they trained at least in the past, before the perestroika?
38. **AS.** Of course. I do remember the scale of the contents and tasks.
39. **P.** It's not by chance that I recalled the military. The matter is that their strategies and strategic training are well elaborated, both theoretically and methodologically. It was from them that the economists used to take the main things, when they got interested in those. Wasn't that so?
40. **AS.** I agree. Even now we understand strategies in stricter terms than economists and managers. We studied both Klausevitz and the others. Even before Christ there were wonderful thinkers. Just to recall Sun Zi.
41. **P.** All that is good. But why do problems with strategy emerge? It does not seem to be a new thing. Can you guarantee that at the General Staff Academy it is possible to train strategists so they can develop the country's strategy? When I am told that Russia allegedly has got no strategy, I wonder if there are strategists in Russia. Where are they trained? Seemingly they should be trained at our Academy of Civil Service. But I'm not so sure about that.
42. **AS.** Speaking from the bottom of my heart, I cannot say for sure that they are trained there. There is no chair of strategy there either. And the training at the Department of Management can hardly be useful in these terms. There is also the Department of National Security there with sufficient number of military. But those can hardly be close to strategic turning points. Surely they take that into account. But that's a different thing.
43. **P.** That's the situation we have. We need a normal strategy. But the situation now is so difficult, complicated and neglected in many respects, that to ensure its high quality quickly will be hardly possible. Do you know why I say so?
44. **AS.** Not quite… I guess, but cannot say with confidence.
45. **P.** Evidently we are weak in real terms, although we had and do have huge capacities. So far, we cannot compete either in the military field (except nuclear shield) or in the economy or in the legal domain. Yes, life has become easier. We are already making progress. But at the background we still have poverty, we lag behind in various fields, our sviense and education are impoverished. So what strategy do we need? Can you tell me what a military officer would feel, given that kind of «concentration» of forces and that kind of «mobilization» of the society, if he was asked to win a war against a fully equipped enemy?
46. **AS.** Goose pimples, to tell you frankly. There would be either a phony victory or a thorough defeat.
47. **P.** So, you understand how smart we have to be among our competitors, don't you? Certainly, there is a degree of rapprochement. They understood what the terrorism is. And we have already accumulated some experience. There is something to work upon together. But that is similar to the situation in a joke: it's all right for us to participate in the races; but we feel uneasy catching up with the others, because then they will see what we wear.
48. **AS.** I feel you're preparing me for an important thesis.

49. **P.** A hard thesis. The matter is that in the nearest future we cannot think about «a grand design», if, of course, we are to be responsible for our words.
50. **AS.** That's evident. I agree.
51. **P.** But this is the first part. Here is the next one. I must prepare and carry out a jump.
52. **AS.** There is a risk of overstraining ourselves right from the start.
53. **P.** In the government, they also tell me about realism. And I am sufficiently realistic myself. But there is the logic of work of big systems. There is a danger of constantly lagging behind, being at the margins of «the Big Seven»; that's, without taking us into account. And «the tigers» follow us closely. Objectively and not without consideration given to the current situation a thrust is needed. A mobilization of the country.
54. **AS.** A strategy of mobilization? A strategy of this jump? Where shall we find the strength, even if we somehow concentrate the resources? Is the society ready for that? I don't think so.
55. **P.** You are right, if one were to pay attention to material resources.
56. **AS.** What about spiritual resources then? I haven't so far met specialists who would say anything reliable and optimistic as regards to such mobilization.
57. **P.** Yes, the situation with spirituality is also difficult at present. Potentially we are very rich in spiritual terms, but so far this is, to a great degree, only potentially.
58. **AS.** Where is the escape? Despite all my respect to you, it's very difficult for me to think optimistically.
59. **P.** It seems to me that our spiritual might, although shaken, is still great. We cannot help the scientists economically. And many mediocrities and empty people have been accumulated in the scientific environment. Though they were always there. And yet, I communicated with a number of scientists and heard a few good thoughts. But there are not enough of them for elaborating the strategy. Too many conditions are to be fulfilled for the science to revive. And without the scientific, cultural and general intellectual mobilization, the task of great leap cannot be solved.
60. **AS.** You've said that yourself. Now I feel more at ease. It's more difficult for you to talk about this. But truth is more important than illusions.
61. **P.** You may consider me to be anybody, but a great leap is necessary for us, a reasonable one, of course.
62. **AS.** That's something! I don't know what to think!
63. **P.** I've got a clear understanding that it is needed, and an intellectual concentration, a mobilization, if you wish, is needed as well; a civilian mobilization too, of course. Also, light-weighted, unrealistic, hurried approaches are inadmissible. You see what a problem it is!
64. **AS.** That goes without saying.
65. **P.** If we do not cover that distance, then dangers will haunt us constantly. We are not Honduras, not Vietnam, not Argentina. We are Russia. And one should trust in our Russia.
66. **AS.** Surely one should trust! Do you want to address the people?
67. **P.** That cannot be done, yet. The solution is unclear. There is no strategy. It is absent because the problem has been just outlined and few people will earnestly support this approach. There are urgent problems and they would overshadow all talk about a great leap . I don't want to be an adventurer in my own eyes and in the eyes of somebody else, too. The problem has not been given shape. There is an indicator pointing at the problem.

68. **AS.** A great leap forward is unrealistic, but it is needed, is it?

69. **P.** Almost, but not so. Here in this thought, I pose in a role of a customer in need of understanding of the problem and searching for the strategy of this leap , a breakthrough to the future. But specialists are needed to carry out the order. The way of thinking now and here, and there as well, hardly matches the depth of the drama. Do you think this is the country's security problem?

70. **AS.** I see the point in that. In the military field, in the economics, in the conflict plane etc.

71. **P.** I believe you think according to the pattern: it is where the enemy is and where the harmful influence is that one should look for dangers. Isn't that so?

72. **AS.** How else?

73. **P.** I've got a feeling that the comprehension of such categories as «danger», «security» and so forth has been oversimplified. It would be good to hold serious discussions and make clear the essence for the selves. So far I feel that the understanding is superficial. Instability, inadequacy to the level of more developed partners, inadequacy of the country to its international status are also linked to danger and security. It is dangerous not to have a normally functioning state, economy, civil society etc. But it is also dangerous not to develop our country in the environment of the others which are developing. There are no enemies, if competitors are not to be counted, but threats still exist, of a different type; that should be dealt with.

74. **AS.** You've introduced such context that I've got no ready-made answer. That requires looking for a sense. Obviously, I am in need of philosophizing too - within my structure. Your thought about a great leap also sounds different from what I've got accustomed to. It seems to me that you have set an unusual problem for yourself. And we, who trust in you and want to work together need yet to grasp all that.

75. **P.** I am not the first forth to put that dilemma. It has not been a rare occasion when national leaders faced the same problem. Peter the Great faced it, Stalin faced it, and many others did. But the method "impossible, but necessary" is not for me. I want to find a civilized approach to solving the dilemma. I don't know yet how , but I do not see any other way. Subjectively I cannot agree with the existing situation. And, most important, my position of the President of the Great Country cannot agree with it. My obligation is to search for the solution. That's the essence. And that should be done fast but not hurriedly. Reasonably fast.

76. **AS.** I'm glad you've trusted me with your idea. I'll try to meet your requirements. First of all, we have to approach the notion of security in a new way.

77. **P.** I would like you to focus on that in your plans :gather together qualified and honest people, without special publicity. Iniytially, try to analyze the problem within a narrow circle. I'll wait for the results: no junk, only the core. Whatever it will be when revealed.

78. **AS.** At your service. I'll report as soon as there are clear-cut thoughts.

79. **P.** I'll wait. See you later.

(After the dialogue with the President)

80. **AS.** Well, I haven't heard such things from him, yet. It's good that he trusts me. However powerful the popular support is, it concerns more the trust and the image, not the deeds. He needs assistance exactly in this. The deed he is designing is superdifficult.

What actually have I understood? He interprets security very broadly; more hard thinking is required here. He has not seen strategists yet, though those talking about strategy are numerous. Also, in his understanding of strategy there is something different, something I'm not accustomed to. And the most original - «a great leap»! How is it possible in our present situation? And yet, there is something in his idea. It is true that we are in a deep pit. We've barely made a step out from total hopelessness. Stability has become to appear. But a great leap would make.. sense only if stability is not a news, when it exists for a long time, when accumulations have been made, and there is something to mobilize. It's enough to recall the examples of mobilization.

Of course, even with small forces a breakthrough can be prepared in a local place. Let's just recall Napoleon, Suvorov and the others. Then there is also Sun Zi's teaching of war. But the President is talking about a breakthrough by the country to be made in the field of competition with the stable countries.

And what did he mean when referring to the possible ways of mobilization? Through a mobilization of the intellectual elite? How to mobilize it, weak and self-loving as it is? Where is the stick used to keep it tense in the past? Can it overcome the lyrics of its egocentrist life and get itself mobilized for the sake of the country? Somehow there is too little light here.

Is there only a dream and a wish in the President's idea? Where are reliable catches here? Of course, the history saw cases when an able ruler created victorious armies out of loose forces. But he was always tough. Besides, an army is not a country. Stalin had his own elite force of fanatical Bolsheviks and an aspiration for a dream, a temptation for the whole people. Of course, he was a master of control, as well. But he had his support. And what about us? Democracy is reduced to individualization and crumbling of everything and everybody, to conveniences for smart dodgers. The people are still struggling for «survival» and just watching, while no spontaneous mobilization for the sake of the country can be seen. The politicians are busy dividing the active part of the population according to their appeals and interests.

All of these must be kept in mind. What is to be done specifically? The notion of security is to be discussed in its essence and more strictly. This will be very useful. It is necessary at least to check up what we've got. There is a need to get together able and active people interested in the country's success, not only their personal one. There are such people, though there are not too many of them.

(A continuation of the dialogue is possible)

WHAT IS RATIONALITY?

© Anatoly Rapoport (*Canada*)

Doctor of Scinces,
Professor

Consider the wide range of situations in which the question "What is X?" can be posed. A person saying "What is this?" and pointing to a gadget may want to know what it is called or else what it is used for. When X is a rarely used word, the person may be satisfied by a dictionary definition. In Socratic dialogues, X frequently referred to some aspect of human nature (virtue, wisdom) or of social order (justice, tyranny). It is noteworthy that in these latter contexts controversies about definitions often arise conspicuously rooted in the value systems of the definers. That is, although definitions of "freedom" or "courage" or "sin" may be intended to declare what these terms "really" signify (their "essence"), they only reveal what the definer thinks they *ought* to signify. This ambiguity has been removed from the discourse of sciences not dealing with humans, their, behavior or their mental processes. One can comfortably call the molecule consisting of two atoms of hydrogen and one of oxygen the "essence" of water in the sense that all properties of water can be in principle deduced from this definition. The same applies to "prime number," "tensor," "energy," "entropy," "insect", "gene," "quark," "probability," "chaos," "autopoesis" - entities assumed to have existed when there were no humans and, therefore, no human language and no human predilections.

The status of "rationality" in this sense is ambivalent. A behaviorist might conceive "rationality" as an aspect of human behaviour, but a Platonist might categorize it along with "logic," "probability," "gravity" or "transcedental number," which, to the Platonist's way of thinking, existed long before humans. Leonard J. Savage, associated "rationality" with *decision making* guided by probabilities of certain relevant events.[1] The term will be so used here.

Another important distinction is between *deductive* (normative) and *inductive* (empirical) approaches to decision theory. The former, developed by predominantly mathematical methods, poses the question how a presumably ra-

tional actor *ought* to make decisions. The latter, based predominantly on experimental approaches, poses the question of how people *actually* make decisions. Rationalilty is assessed by the consistency of their rationalizations of decisions.

Finally, I shall introduce an ethical dimension into the theory of rationality, until recently excluded in the behavioristic (reductionist) approach and by the dogma of "value-free" science. Introspection, also once exluded from behavioristic psychology, will play a central role in the analysis of *reflexion* (*N.B.* not to be confused with "reflection") as a principal component of the human psyche.

1. Expected value of a gamble (Pascal's thesis)

The story that links "rationality" and "probability" may be familiar to any one interested in the origins of rigorous decision theory. It is retold here in the interest of continuity. One Chevalier de Mere, apparrently a philosophically inclined gambler, raised some questions related to "fairness" in certain games of chance. A simple version of one of them is the following. She and He play at tossing a coin under following conditions. If the coin falls "heads," She gets a point; if "tails," He. The coin is to be tossed until one or the other gets 10 points and thereby wins the stake. For some reason the game is interrupted when She has accumulated 8 points and He 9. How should the stake be divided?

She suggests that the stake be divided proportionately to the points obtained, that is $8/17$ of it to her and and $9/17$ to him. He argues that he should have a larger share, namely $2/3$ of the stake, while She should be content with $1/3$. He reasons as follows:

"After at most two tosses of the coin, one or the other of us will have accumulated ten points. There are three possibilities. (1) The first toss is tails, in which case, I would have won. (2) The first toss is heads, the second tails, in which case I would have also won, since She would have nine points and I ten. (3) Both tosses show heads, in which case, She would have won, since she would have ten point and I nine. Thus, I would have won in two out of three ways the game could have continued, that is, two thirds of the time. I am therefore justified in claiming two thirds of the stake."

He claims a considerably larger portion of the stake than 53%, which She is willing to concede. Accoding to Blaise Pascale, however, He is too modest. On reflection, one sees that two tosses could result in four different outcomes: HH (both times "heads"), HT (first "heads," then "tails"), TH (first tails, then heads), TT (both times tails). If the coin is not biased, each outcome would have been equally probable, that is would occur in the long run once in four tosses. Since (in the long run) three out of the four ourcomes would award the stake to him, He can reasonably claim $3/4$.

It was Pascal, who introduced a potentially rigorous concept defined in terms of objective probability, namely "expected value," and the associated norm of "rational choice," which governs the "fair price" of a gambling wager.[2] In our time, the entire outlook is representable by a matrix, whose rows designate possible actions (wagers) chosen by a "rational agent," while the columns represent relevant "states of the world." The intersection of a row and a column represents the increment of the agent's fortune (positive or negative), which results if he/she chooses the particular row, and the "state of the world" represented by a particular column obtains.

As an example consider the following gambling device. Inside the device there are 6 cards: King of Diamonds, Queen of Hearts, Jack of Hearts, King and Queen of Spades, Ace of Spades. The machine delivers an amount of money depending on the card bet upon and the card shown.

STATES OF THE WORLD

	0.1	0.2	0.2	0.1	0.1	0.3
	K Hearts	Q Hearts	J Hearts	K Spades	Q Spades	A Spades
King	$1	$0	$0	$1	$0	$0
Queen	$0	$3	$0	$0	$4	$0
Ace	$0	$0	$0	$0	$0	$10
Etc.	. . . .					

Above the matrix, the probabilities of the "states of the world," are shown, that is, probabilities that a particular card will appear. The entries in the rows of the matrix indicate amounts paid to the gambler if each of the the cards appears. For example, if a bet is placed on "King," the machine pays out $1 + $1 with repective probailities 0.1 , 0.1, that is, $2 with probability 0.2. Thus, the *expected value* of betting on King is $0.40. Similarly, the expected value of betting on Queen is 0.2($3) + 0.1($4) = $1. The expected value of betting on an Ace is 0.3($10) = $3. Assuming, our gambler knows all this, he bets on Ace - hoping for the maximum expected gain. But it is not the *guaranteed* gain. There is a particlar probability that any card will appear. In particular, the Queen of Spades could appear (with probability 0.1), in which case our gambler would get nothing.[3] Nevertheless, according to Pascal, betting on Ace was the "rational" choice. (It maximized *expected* gain "in the long run," if the gambler alwys bet on Ace.)

Are decisions guided by expected gain always rational?

Consider the following game. If a tossed coin falls "Heads" for the first time on the n-th throw, the gambler receives $2ⁿ, and the game is over. Thus, if "Heads" is the result of the first throw, the gambler receives $2 ; if first on the second throw $4 .... if on the tenth, $1024 , and so on *ad infinitum*. Since the

probability that the ftrst Heads shows in the nth throw is 2^n, the expected value of this game is given by

$$\$2(1/2) + \$4(1/4) + \$8(1/8) + \ldots \$2^n(1/2^n) + \ldots =$$
$$\$1 \qquad +\$1 \qquad +\$1 \qquad +\$1 \qquad\qquad +\ldots \textit{ (ad infinitum)}$$

Since this series does not converge, the expected value is infinite. This means that a "rational" gambler should be willing to pay any finite amount of money, in fact, his entire fortune for the privilege of playing this so called "St. Petersburg Game" once. To my knowledge, no one has ever made a bid of this sort. Yet, according to the principle of "moral expectation" arbitrarily large bids should be made by "rational gamblers." The conclusion is unavoidable that either there are no "rational" gamblers or else, more reasonably, that "moral expectation," that is, betting on maximal statistically expected payoff (as defined by Pascale) is not always an adequate criterion of rationality.

This paradox led to the concept of "utility," in particular of money and more generally of any "good" (or "bad"). It seems reasonable to assume that the "amount of satisfaction" associated with money, while increasing with the amount of money in possession, does not increase linearly. For instance, a gain of two million dollars does not necessary make one twice as happy as a gain of one million dollars. On the other hand, it is reasonable to keep the assumption that money does bring happiness (though not proportionately to its amount). To be sure, there are many things that money can't buy, but then there are many it can. At any rate, one can assume (or convince oneself) that one can always throw away any superfluous amount of money.

Attention to this problem was, it seems, first called by Nicholas Bernoulli, a member of the illustrious Swiss family of mathematicians. Its theoretical basis was initially developed by Daniel Bernoulli.[4] Daniel proposed to represent the *utility* of money by the *logarithm* of accumulated fortune.[5] The logarithmic function is "convex," that is, the slope of its graph, while remaining positive decreases, exhibiting so called "diminishing returns." In this case "moral expectation" in the St. Petersburg game will show a maximum, that is, the maximum amount that a "rational gambler" should be willing to pay for the privilege of playing the game once. Unfortunately, this modification did not help. It is possible to design a variant of the St. Petersburg game that makes the "moral expectation" induced by logarithmic utility function unbounded. Only a "ceililng" on utility of money leads out of the paradox. If so, the personalistic moment cannot be removed from a model of "rationality." You and 1 may have very different ideas about how much is enough, which makes it impossible to decide who of us is "objectively" more "rational" than the other.

L. Savage got around this difficulty by assigning a "personalistic" utility function to each individual analogous to personalistic probability. He then

put restrictions on these personally individualized criteria which would exclude contradictions or inconsistencies in assessing probabilities of events or utilities of outcomes in the subject's estimation. The following imaginary experiment illustrates the sort of test a subject must pass if his assignment of probabilities to events and, accordingly to utilities of outcomes, are free of contradictions.

Testing the consistency of a personal utility function

We ask a subject to evaluate preference among four fruits: (A)pple, (B)anana, (C)oconut, (D)ate. Suppose he ranks them in the order of preference $A > B > C > D$. These inequalities determine the subject's preferences on an *ordinal* scale, from which we can infer which fruit is preferred to which but no by how much. We need to establish the preferences on at least an *interval* scale. Which will show the relative sizes of the "gaps," between degrees of preference. This can be done in the following way. We arbitrarily assign "1" to Apple (the most preferred) and "0" to Date (the least preferred), which fix the utilities of the two. We now seek the numerical values of the intermediate utilities. We offer our subject a choice between B and lottery ticket that awards A with probavility p or D with probability $(1 - p)$. Thus, if the subject chooses B, we increase p, thus making the lottery more attractive (more chance of getting the apple). If she chooses the lottery, we decrease p. We continue adjusting p, until the subject is indifferent between p and B. Since the value of the lottery is $p(1) + (1 - p)(0) = p$, we conclude that the utility of B in our subject's estimation is p. Using the same procedure, we can establish the utility of C, say q. Note, however, that we can estabish the utility of C in another way, namely by asking the subject to compare C with a lottery that awards C with certainty or a ticket to a lottery that awards B with probability r or D with probability $1 - r$. Since we have established the utility of B as p, the expected value of the lottery is now $r(p) + (1 - r)(0) = rp$, and this should be the utility of C for our subject when she is indifferent between C and the lottery. If she is consistent in her evaluation of the utilities of the four fruits, we must have $rp = q$. And this may or may not be observed. The question arises how consistent are people in situations of this sort; in other words how "rational" are people in conceiving their estimates of probabities and their preferences on an interval scale?. This question has to be faced, if maximization of expected utility is to serve as a robust principle of a theory of rational decision. It seems, too much is often taken for granted in developing a theory of decision based on this principle.

A formalist's definition of a rational decision

Consider the following passage. The author discusses the process of becoming informed (a prerequisite of rational voting), in particular, "the quantity of information it is rational to acquire".

The information seeker continues to invest resources in procuring data until the marginal return from information equals the marginal cost ... These factors determine the size of the planned investment. The first is the value to him of making the correct decision as opposed to an incorrect one, i.e. the variation in utility incomes associated with possible outcomes of the decision. The second is the relevance of the information to whatever decision is being made. Is acquisition of the particular bit of knowledge likely to influence the decision one way or another? If so, how likely? To answer these questions, a probability estimate must be made of the chances that any given bit of information will alter the decision. This probability is applied to the value of making the right choice (the vote *value* in our example). From this emerges the return from the bit of information being considered, i.e., the marginal return from investment in data on this particular margin. [6]

The passage cannot possibly be a credible description of a "rational voter's" behaviour. It is clearly meant as *prescription* of how a "ratonal voter" *should* arrive at a decision of whether or how to vote. But it is highly unlikely that prescriptions of this sort are ever taken seriously. For instance, just how can a probability estimate be made of the chances that any given "bit of information" will alter the decision? It seems that this passage makes sense only as a tacit declaration that the only rational being is *homo economicus* (a homunculus whose world is a casino). In what follows, 1 shall avoid this tacit assumption.

2. Rationality outside the casino

Consider the following elementary example. Going to work, you are trying to decide whether to take the umbrella or not . You consider two possible states of the world - Rain or Shine. There are four possible outcomes: (1) Umbrella along and Rain; (2) Unbrella along and Shine; (3) No umbrella along and Rain; (4) No umbrella along and Shine. Perhaps you order these outcomes from "best" to "worst," that is on an ordinal scale, for example, (4) > (1) > (2) > (3). Similarly, the chances of rain can be represented by an ordinal scale, indicating which is more probable ("Looks like rain" or "Doesn't.") However, these judgments are not sufficient to compare the *expected utilities* of the two decisions and so the choice between them. As we have seen, maximization of expected utility makes sense only if both probabilities of the states of the world and utilities of the outcomes are given on a scale at least as strong as the interval scale. As we have seen, however, construction of a *consistent* interval scale of subjective preferences is not a task lightly undertaken. I venture to assume that you do not undertake it.
Rather, at most you venture to create it by the way you "feel," namely about chances of rain and about you ranking of the outcomes. Your utilities matrix may look like this:

Probabilities	0.6	0.4
States of the world	Rain	Shine
Umbrella along	0	−1
Umbrella left home	−5	10

The probabilities reflect "Rather looks like rain" or "Doesn't." The 0 reflects chagrin about rain, cancelled by satisfaction of taking umbrella along. The -1 reflects chagrin of lugging umbrella in good weather and the likelihood of forgetting it on the subway. The -5 represents the worst situation (getting wet), the 10 the best situation. Applying now maximization of expected utility, we have U(umbrealla along) = (0.6)(0) + (0.4)(−1) = −0.4; U(unbrella left home) = (0.6)(−5) + (0.4)(10) = 1 > −0.4. Therefore, leave it home even "if it looks like rain."

Note that the decision is "tailored" to your hunches and feelings, which are not evaluated by their "consistency," as are Savage's personalized probabilities and utilities. This is because Savage was concerned with very special decision problems, reflected in the title of his book, *Foundations of Statistics.* In modern statistics, the problem is not compilation of data (as it was originally) but assessing the degree of confidence we have in the truth of a given hypothesis arising in scientific research. In that context, which necessitates very rigorous definitions of probability and "degree of confidence," criteria of rationality are far more stringent than in every day life. In sum, criteria of "rationality" are more stringent in decisions undertaken in scientific research (the business of reinforcing or undermining beliefs about what is true) than in every day life.

3. Decisions under uncertainty

So far we have been concerned with "decisions under risk" – where probabilities of events were given or assessed intuitively. In "decisions under uncertainty," probabilities of events are not given. We will examine three methods of arriving at decisions in situations of this kind. Let S_j signify "states of the world," A_j acts, entries utilities of outcomes associated with acts and states of the world.

	S_1	S_2	S_3	S_4
A_1	−2	−3	3	8
A_2	−1	−1	3	0
A_3	−2	0	2	6

Suppose our actor is completely ignorant of the probabilities with which the given states of the world can occur and no way of estimating them. He thinks he can do no better than assume that the states of the world are all equiprobable. If so, the expected utilities of the three acts are respectively 1.50, 0.25 1.50. Thus A_1 seems to be a rational choice. Next, suppose our actor is a

deep pessimist. He assumes that the worst possible will always happen to him. Accordingly he examines the worst possible payoffs associated with the respective acts and finds that of these −1 in the second row is the "least worst." He will choose A_2. Finally, suppose our actor always worries about what he should have chosen in these circumstances rather than what he actually chose. Accordingly, we construct a "regret" matrix. The entries are intensities of regret experienced by the actor after the act.

	S_1	S_2	S_3	S_4	
A_1	1	3	0	0	3
A_2	0	1	0	8	8
A_3	1	0	1	1	2

Consider the entries in the first row. Suppose the actor chose A_1. Then if S_1 occurred, he would regret that he didn't choose A_2 since his regret might have been 0 instead of 1 . Consequently, his regret in the first row, first column is 1. If, on the other hand, S_2 occurred, he would regret not having chosen A_3. "Had I chosen A_3," he might have mused, "I would get 0, which is 3 more than −3. Therefore, my regret is 3." The other entires in the matrix are interpreted similarly. The column on the right indicates the maximal regrets associated with the three acts. The actor chooses the act which minimizes this maximum ("mininimax regret"). In our example, A_3 is "Had I but known" actor's best choice.

In the light of these examples, it seems that actors can be regarded as rational, even if they choose different acts in the same situation. In the absence of any way of estimating the probabilities of the various possible states of the world, each actor may determine his/her choice by what this formally defined utility is worth to her/him in a particular situation. Suppose, for instance, a given monerary value is placed on human life in a particular situation, e.g., paying out life insurance to survivors of persons killed in traffic accidents. Recall that during World War II, speed limit on highways was reduced in the U.S. to 40 miles per hour (to save gas and rubber on tires). Accordingly fatalities decreased by some 15,000 per year. Shortly after the war, the speed limit was raised back to its pre-war level, whereupon the mortality also returned to previous levels. On the basis of these data, someone calculated the apparent monetary worth of a human life, which turned out to be about $ 100,000 per capita, that is, money saved by commercial enterprizes (e.g. trucking companies) in consequence of raised speed limit. On the other hand, millions are spent in attempts to rescue a single miner trapped underground. Life jackets for every passenger are available on all transoceanic flights. To my knowldge, none have ever been used. This is an example of "worst case scenario" decisions. Such examples indicate unavoidable inclusion of an ethical, psychological, or ideological factors in evaluating the

rationality of decisions by a given category of actors in a given context. To put it bluntly, *homo economicus* is not a good general model of a rational decision maker. The same can be said of *homo geopoliticus.* Apparently reasonable criteria of rationality can be easily postulated that are not satisfied by any one outside a casino or a think tank. On the other hand, criteria may be so tightly bound to particular values of particular classes of decision makers, as to regard all of them as "rational" and thus reduce rationality to a nonfalsifiable property, hence a vacuous context. In what follows, more attention will be devoted to this aspect of rationality.

4. Casual and evidential theories of rational decision

Suppose on a Monday morning you are on the way to your bank and meet your friend, Dr. Noitall, a person fabulolusly rich and practically omniscient in the sense that he can predict with almost perfect accurracy how any person he meets and talks to for a while will decide in a given "Yes or no" situation. This was established by an experiment. One hundred persons were asked to make a "Yes or no" decision independently. Fifty decided one way, fifty the other. Dr. Noitall had correctly predicted every one's decision but one.

Dr. Noitall shows you ten crisp $100 (U.S.) bills and invites you to accept them. To your question "What's the catch?" he replies, "Last Friday I was at our bank and either deposited or did not deposit $1,000,000 (U.S.) to your account. If I predicted that you would accept the $1,000, which I am offering you now, I have not deposited the million; if I predicted that you would refuse, I did deposit the million. Please note that the money either is there or is not, and nothing that either you or I can do now can change the situation.

You say, "You mean if I accept the $1,000 I get nothing more, while if I decline it, I get the million?"

"Not quite," he says, "that million either is there or else it isn't. Whether it is or not does not depend on what you decide now. It depends on what I predicted. If I predicted that you would decline the $1,000, I deposited the $1,000,000 to your account; if I predicted that you would accept the $1,000, I didn't. It's either there or not, and nothing that happens *now* can change the situation. Think it over; take your time. Remember that I have always predicted your decisions correctly.

Consider the decision matrix. The columns represent two possible "states of the world": that Dr. Noitall predicted that you would take the money, or that he predicted that would refuse it. The upper row represents your decision to take the money; the lower row that you refuse it. The cells of the matrix represent the results of your decision coupled with Dr. Noitall predictions.

	Noitall predicted that you take the money	Noitall predicted that you refuse
Take the money	$1,000	$1,001,000
Refuse the money	$0	$1,000,000

If this is the way you picture the situation, you subscribe to *causal decision theory*. This means you assume that if he predicted that you take the money, he put nothing in your account; so taking his offered money gets you $1,000; refusing it gets you nothing. On the other hand if he predicted that you refuse the money, he put $1,000,000 in your account; so refusing the $1,000, you get $1,000,000. In sum you are better off taking the money *whatever* Noitall predicted. Your decision one way or the other *caused* the state of the world.

However, there is another way of constructing the matrix.

	Predicted "will accept"	Predicted "will decline"
Accept	$1,000	Impossible
Decline	Impossible	$1,000,000

If this is the way you picture the situation, you subscribe to *evidential* decision theory. For prediction that you will accept is *evidence* that the money is not there. Prediction that you will decline is evidence that it is. You cherish the evidence of good news and act accordingly.

The paradox (the different conceptions of "rational decision") stems from a change of assumptions about the relationship between actions and states of the world. In the classical model of decisions under risk or uncertainty, it is assumed that the "states of the world" are in no way influenced by the decision maker's actions. In so called "evidential" decision theory an actor's decisions influence the "states of the world" *as these appear to her*. If you subscribe to this decision principle, you must assume that your decision to decline the $1,000 is "evidence" that the $1,000,000 has been deposited to your account and if you accept, this is "evidence" that the million is not there. You act on this "evidence." On the other hand, in the light *of causal* decision theory,[7] your decision influences the *actual* state of the world (not just your conception of it) and leads to a different conclusion about what is a "rational" decision in this context.

The devout beliver in predestination

Let us see how "evidential" decision theory is manifested in real life. In some Christian sects (e.g., Presbyterian, Calvinist) believers assume that who has been "saved" has already been determined ("predestination"), and nothing one can do can change his condition. Suppose you ask such a believer, "Why do you try to lead an exemplary life? Why don't you have a good time, drink, gamble, chase women? After all, how you live can't affect your destiny. You are either destined to go to heaven or to hell, no matter what you do or

don't do." The Calvinist may reply as follows. "Since God is just, it is almost certain that those and only those who live an exemplary life are saved. By living an exemplary life I become convinced that I am saved. And this certainty is worth more to me than the alleged pleasures of debauchery."

Come to think of it, not a bad answer. And that's the sort of rationalization you might offer if asked to justify your decidion to reject the $1,000. You cherish the *feeling* that you've become a millionaire.

5. Enter the other

So far, rationality was ascribed (or not ascribed) to a single decision maker. One might think that our first example - the argument about how to divide the stake of a coin tossing game - involved two actors with conflicting interests. However, neither SHE nor HE made any decisions in that situation; they only offered arguments about how the stake should be divided. Chance could be said to have made decisions in the course of the game - let the coin fall "heads" or "tails." But she had no *interest* in the outcome and hence was not regarded as a player of a game, whom we shall henceforth regard as an *actor*. Such an actor is ordinarily thought of as an individual, but it could also be a firm, an institution, a battalion, or a state. Situations involving two or more actors in the sense described can be conveniently classified as Two-person or N-person (N > 2) games - constant-sum or variable-sum; cooperative or non-cooperative. We shall discuss examples of some together with possible meanings of "rationality" relevant to each kind.

The two-person constant-sum game

Like a problem faced by a single decision maker, a two person game can be represented by a matrix. Here the rows and columns respectively represent the "strategies" (possible courses of actions) by the respective players. The entries are pairs of payoffs to the respective players that result when a pair of indicated strategies is chosen. In a constant-sum game, the sum of these payoffs is constant, and, in view of their expression on an interval scale, they can without loss of generality be assumed to be zero. An example of a two-person zero-sum game is shown in matrix form. The two players are SHE and HE. The rows represent her strategies, the columns his. Each chooses his/her strategy independently. The intersection of the row and column is the outcome of the game. The first number is her payoff, the second his.

	HE		
	−3,3	18,−18	−20,20
SHE	−1,1*	5,−5	2,−2
	−2,2	−4,4	15,−15

A two-person zero-sum game with a saddle point

Note that her payoff in the second row, first column (−1) is the largest in the column and the smallest in the row. His payoff in that cell is the largest in the row and smallest in the column. Such a payoff, here distinguished by a star, is called a *saddle point*. It represents the *maxmin* (the rational "worst case scenario"outcome) for each player. Let us show that this pair of strategies is optimal for both players.

SHE reasons as follows: "Suppose I choose the second row (where my maximin payoff is). What column would HE choose if he knew this? Clearly the first column, where his maximin is. *Mutatis nititandi,* if 1 knew that HE would chose the first column, I would chose the second row. HE reasons exactly the same way and we arrive at the saddle point as the "rational" solution of the game.

Some two-person zero-sum games have several saddle points. However the payoffs of all of them are always equal and whichever row or column is chosen containing a saddle point, the outcome is always the same pair of payoffs. Such saddle points are said to be *interchangeable*.

An elementary Hide-And-Go-Seek

The next matrix represents a simplest version of "Hide-and-Go-Seek," a game in which each player has a simplest possible choice - of just two strategies.

		HE	
		G_1	G_2
SHE	H_1	−2,2	4,−4
	H_1	2,−2	−1,1

SHE hides either under the bed (H,) or in the closet (H_2). HE goes seeking under the one (G,) or in the other (G_2). The payoffs represent the degrees of success or failure. (For instancce, it is worth more to him to find her under the bed (2) than in the closet (1).)

Note that this game has no saddle point. However, it has an "equilibrium" outcome, resulting from *mixed strategies*. A player resorts to a mixed strategy if she chooses each of the available strategies with some probability. In our Hide-and-Go-Seek game each player can mix his/her two strategies in any proportion. For example SHE can hide under the bed with probability $3/8$ and accordingly in the closet with probability $5/8$. Similarly HE can look in either place with some analogosus probabilities. The problem faced by each is to decide on the best mixture. In our example, it turns out that SHE does best if she hides under the bed with probability $1/3$ and in the closet with probability $2/3$. HE, on the other hand, should look under the bed with probability $5/9$

and in the closet with probability 4/9. In consequence SHE will have an expected payoff of 2/3 and HE will have an expected payoff of-2/3. Neither can improve her/his expected payoff by using any other mixture, provided the other player uses his/her optimal one.

A saddle point or a pair of mixed strategies of this sort determine a so called a *Nash equilibrium*. It has the property that neither player (or no player in games with more than two players) can improve her expected payoff by unilateral departure from the strategy she uses in the equibrium. As we shall see, some games have several Nash equilibria, that, unlike saddle points in constantsum games, are not interchangeable. Most game theoreticians assume that a rational solution (a particular choice of strategies by the players) in a noncooperative game must be a Nash equibrium. The problem of finding *the* rational solution of the game is that of choosing among these equilibria as the "most rational" solution after imposing certain requirements on the outcome deemed to best reflect rationality. Some feel uncomfortable with this critrerion of rationality. In some games the "most rational" Nash equilibrium may be *Pareto-deficient,* in the sense that another outcome of the game may have a greater utility for both or all players and so can be regarded as a "rival" of a Nash equilibrium for the title of "most rational."

Prisoner's dilemma

This paradox is evident in the first game with the soubriquet "dilemma" in its name, namely Prisoner's Dilemma [8].

		Prisoner 2	
		C_2	D_2
	C_1	1,1	–10,10
Prisoner 1			
	D_1	10,–10	–1,–1*

C denotes "cooperation," D "defection." The outcome (–1,–-1) is the only Nash eqilibrium. However, both do better if they cooperate (C_1, C_2) than if both defect (D_1, D_2). So what is the rational choice? Some would say (C_1, C_2), which is Pareto efficient, whereas (D_1, D_2) is Pareto deficient.

Since the discovery of this game, attention of many social psychologists turned to the distinction between individual and collective rationality reflected in many real life situations. If a fire breaks out in a crowded theatre, it is individually "rational" for each to get to an exit as quickly as possible. But if every one tries, all may perish. It is "rational" for each fishing fleet to get as large a catch as possible, but if every fleet strives to become more efficient, there may eventually be no fish to catch. The relevance of the Golden Rule to collective rationality is evident, especially its generalization by Immanuel Kant:

"Act as you would wish every one to act." Application of this rule leads to the cooperative outcome in Prisoner's Dilemma, to the prudent outcome in Chicken (see below), to conservation of the environment and to conscientious discharge of a citizen's duty – to vote in a democratic election.

The game of brinkmanship

The game commonly called "Chicken" is exemplified by a war of nerves. Two cars rush at each other each hogging the middle of the road. The first to swerve earns the contemptuous epithet "chicken" (coward), that is, loses the game. The following matrix displays the game.

		Dare devil 2	
		Swerve	Don't swerve
	Swerve	1,1	−10,10*
Dare devil 1			
	Don't swerve	10,−10*	−100,−100

Note that, like Prisoner's Dilemma, this is not a zero-sum game. It has three Nash equilibria, two in the zero-sum outcomes, one in a mixed strategy outcome, namely when each player swerves with probability 10/11 and doesn't with probability 1/11. In choosing among these three as the "most rational" equilibrium, we note that we cannot justify preferring either of the zerosum outcomes of which one favours Dare Devil I, the other Dare Devil II. Nor can we choose the disastrous outcome (−100, −100) as "rational," since each player *can* improve his outcome by swerving. There exists, however, another Nash equilibrium – a mixed strategy, realized by the mixture (10/11, 1/11) which awards an expected payoff of 0 to each. The trouble with this outcome is that the two desperadoes can do better than that if both always swerve (retreat from the brink), thereby getting a certain payoff 1 instead of expected payoff 0 (resulting from the mixed strategy).

Besides, by choosing to swerve, both eliminate the chance of being killed. Nevertheless, this "best for both" outcome is rejected by game theorists who insist that only a Nash equilibrium can be called "rational" in games of this sort, since it induces no temptation to defect (beat the other to the draw, so to say) and so get a bigger payoff. In contemporary geopolitics, this "beating to the draw" is called "preventive strike." Clearly, however, both could do better if each refrained from entertaining thoughts of a preventive strike and trusted the other to do the same.

Like Prisoner's Dilemma, Chicken illustrates the difference between individual and collective rationality.

6. Ethical and ideological components in the conception of rationality

A non-constantsum game called "Volunteer's Dilemma" is exemplified by the following situation. In an institution where discipline is strict and the authorities are not always fair, a transgression has occurred. The authorities demand the culprit(s) to identify him/her/themselves. Those who confess will be mildly punished. If no one confesses, every one will be severely punished. The situation is perceived in different ways by the innocent and by the culprits, if any, and by the informed and the uninformed of the identity of the culprits. The guilty must weigh self interest vs. conscience, solidarity with colleagues, and collective interest. The innocent must weigh self-sacrifice vs. redundancy, in case others decide to confess. The rebellious must weigh the imperative of non-cooperation with the authorities vs. solidarity with fellow-inmates. The situation is represented by the following game matrix. C stands for "confess," D for "deny."[9].

Number of C choosers	0	1	2	3	...	n-1	n
Payoff to C choosers	–	u–k	u–k	u–k	. . .	u–k	u–k
Payoff to D choosers	0	u	u	u	...	u	–

A real life instance of Volunteer's Dilemma was the notorious Genovese murder case.[10] 38 residents of an apartment complex watched from windows while a woman was being murdered on the street below, and no one called the police. The case stimulated much discussion about erosion of compassion, of civil responsibility and the like. But it may well have been an instance of every one's conviction that some one *must* have called the police, hence that it makes no sense to stick one's own neck out. This situation is neatly exemplified by the eloquent word in the (now extinct) Fuegian language – *mamihlapinapatai.* It means "Two people looking at each other, each hoping that the other will do what must be done."

The issues of the game can be generalized as follows. Let u, represent utilities of public goods, which members of the population produce (cooperators) or fail to produce (free-loaders); k' costs of producing them ($i, k = 1 ... n$). A cooperator (using strategy C) receives $u_i - k'$, a defector (using strategy D) receives u_i if there is at least one cooperator, otherwise 0. The game has N Pareto-efficient equilibria with exactly one cooperator and N – 1 defectors. An additional eqilibrium in mixed strategies may exist, whereby D_f is chosen with probability q_i ($i = 1, 2, ... n$).

<div align="center">

The case of the drowning child

</div>

A child fell from a bridge into the river. The question in every one's mind is who is to jump in to try to save the child. In the crowd is the father, who happens to be the strongest swimmer and understandably the most concerned.

Common sense prescribes that he is the one who should jump in. Let us analyze the situation as an "asymmetric" Volunteer's Dilemma in the sense that each bystander is characterized by his/her degree of concern about the child (corresponding to u_h the utility of the "public good," that is of rescuing, the child) and his/her swimming skill, that is k, the cost of producing u. We assume that the father is the most concerned (characterized by maximal u) and also the best swimmer (maximal k). Let N be the number of bystanders. Clearly, the game has N Nash equilibria (all Pareto efficient), namely one of the bystanders jumps (only one is needed to rescue the child) and we assume that all the "participants in the game" are sufficiently competent to do so, albeit with varying skills. Besides these "pure" strategies, the game may have additional equilibriua in mixed strategies, which reflect the probabilities with which the bystanders are likely to "volunteer." Among these there is one which makes it *least likely* that the father of the child will try to save the child! Diekmann comments: "This is a very paradoxical result which hardly will be in line with observed behaviour of individual decision makers. An explanation in formal terms is that the mixed equilibrium strategy yields the maximin payoff, which is higher for "strong" players with either greater interest u_i or lower costs k_i. In order to achieve at least the maximin payoff, a "stronger" actor's defection probability has to be greater than the defection probability of co-players with a lower maximin payoff"[11].

What price deterrence?

D.G. Brennan, in reviewing my book *Strategy and Conscience* [12] posed the question : "Under what circustances is it ethically reasonable to use how much military force? ... How many people can be reasonably risked as a consequence of some particular deterrent system?"[12]. Herman Kahn, author of *On Nuclear War,* proceeded to answer the last question. "1 have discussed [it] with many Americans and after some fifteen minutes of discussion their estimates of an acceptable price generally fell between 10 and 60 million, clustering toward the upper number."[13] That's quite a lot, about a third of the U.S. population at the time this was written. But of course, this must be multiplied by the "probability" that deterrence fails. And how is this to be done? How can the probability of an outbreak of a nuclear war be estimated? Surely not in terms of frequencies of nulcear wars under specified conditions, since we can expect at most one or, perhaps, two to occur, hardly more. Nevertheless, estimates of "probabilty of a nuclear strike" have been made. It is said that they were made by members of J.F. Kennedy's entourage during the so called Cuban Missile Crisis. Some of the "dovish" advisors ventured to estimate the chances at 50%, the more "hawkish" ones at 30%, and "rational" (as distinguished from "emotional" decisions) were to be made on the basis of such estimates.

What price success?

At a gathering of corporate executives, I demonstrated a simplified version of an N-person game invented by D. Hofstadter.[14'] The prize for winning the game, sponsored by *Scientific American* was $1,000,000. (Hofstadter assured the publishers that they would not have to pay anything.) I didn't have that much money, but I had some thousands of dollars from a research grant, which I had no misgivings in risking, being assured with near certainty that I would not have to pay anything. The rules of the game are simple. Each person participating writes a number on a piece of paper. These are collected, and the person who wrote the largest number wins $1,000 divided by the number he wrote. In case of ties, the prize is to be equally divided among the winners.

The dilemma in this game is the circumstance that no matter what number one writes, the next one, if it is to be the winning one, is expected to bring more money. One can reason as follows. Suppose one submits N, thinking that it will be the largest number submitted. "But if I think so," the player reasons, "I can suppose that every one thinks so. Then if there are P participants, each will receive $1000/NP. But then I can submit N + l and be the only winner, that is will win $1,000/(N+1)$, which more than $1,000/(NP)$, since $NP > (N + l)$ if $N > 1, P > 1$. So it's better to choose N + 1. But again, if I think so, so do the others.... I must therefore submit the largest number 1 can think of, hoping that no one submits a larger." And sure enough one of the players submitted something like Avogadro's number (6.025×10^{23}) or "Googol" (10^{100}), or, perhaps, "Googolplex" $(IQ^{0''080'})$. This corporate executive won hands down. I congratulated him and apologized that 1 can't pay him the exact amount he won, which, would be, an invisibly minuscule fraction of a penny. But 1 would gladly pay him a penny. The winner, was jubilant. "But I won, didn't I?" he pointed out, accepting the penny.

The examples were meant to illustrate the power of ideological commitment, which all too frequently blocks the path to decisions that can reasonably be called "rational." In particular, the collectively rational decision in the above game was for every one to choose "T."

7. Rationalty from the point of view of reflexion theory

The principal theme of reflexion theory, developed most intensively and extensively by Vladimir Lefebvre,[15)] has been the rehabilitation of the psyche as an important object of investigation in psychology. It will be recalled that introspection, which had been a principal tool of investigation in the formative years of scientific psychology was declared unwelcome by investigators of the rapidly developing behaviorist school. The behaviorists accepted only collec-

tively observed aspects of overt behaviour as primary data. The reason is not far to seek. Experimentation on non-humans made effectively controlled investigations and practically uninhibited manipulation of subjects possible. There is no denying that psychological science (perhaps more aptly called behavioral science) made rapid progress in the heydays of experimental psychology. Still, dismissing introspection as lacking objectivity is not fully justified. Results of instrospection can be compared by investigators, describing their findings independently. For example, there is no doubt that *deja vu* is an objectively existing phenomenon, even though this has been established by introspection alone.

1 will confine myself to describing two concepts, referring to human and only human psychology, since both are results of introspection, namely, a pair of ethical systems that can be regarded as "duals" of each other, and multi-tiered instrospection. The latter was described over a century and a half ago by L. Tolstoy in his autobiograpical novel *Childhood.* The youngster (referred to in the first person) asks himself, "What am I thinking about?" and answers, "1 am thinking, 'What am I thinking about'." The next question is inevitable: "And now what am I thinking about?" The anwer is, "I am thinking "What am 1 thinking about, 'what I am thinking about' ..." The young philosopher is terrified by the discovery that there is no end to this inquiry. He wasn't the only one. More than one logician or mathematician felt discomfort when the quicksand of self-reference was discovered by B. Russell. If I were superstitious, I would probably believe that Bach killed himself by self reference. Shortly after he inserted the tones B-A-C-H as one of the themes of his masterpiece, *Die Kunsl der Fuge,* he died, leaving the work unfinished.

The two ethical systems

Lefebvre suggested that human values are moulded by either of two ethical systems. The first, in his opinion, charcacterizes American culture, while the second was predominant in Soviet society. The extent to which this hypothesis is supported is seen in the results (see the table) of the experiment.[16]

Lefebvre defines "Boolean algebra" as a calculus with two binary operations, "+" and " · " , a unary operation "−" and elements 1 and 0. The first eight axioms establish that both operations " + " and "· " are associative, commutative and distributive with respect to each other. Further axioms are deduced by representing b → a (in symbolic logic "b implies a") as a^b. This gives meaning to exponentiation in Lefebre's version of Boolean algebra and "legitimizes" all the operations including exponentiation.

As an example, suppose *A* and *B* are idividuals in the first ethical system, so that a + b means that they are in conflict. Further, suppose their relationship,

Statements	USA		USSR	
	Agreed, %	Confidence interval, %	Agreed, %	Confidence interval, %
1. A doctor should conceal from a patient that he has cabcer, in order to relieve his suffering.	8.0	±6.8	89.0	±6.7
2. A doctor should not conceal from a patient that he has cancer.	80.5	±9.9	15.8	±8.0
3. A malefactor can be punished more severely than the law requires, if this may serve as a deterrence for others.	11.5	±8.0	84.5	±7.8
4. A malefactor cannot be punished more severely than the law requires, even if this may serve as a deterrence for others.	83.6	±9.4	28.0	±9.9
5. One may give false evidence in order to help an aiinicent person avoid jail.	19.9	±8.4	65.0	±10.0
6. One must not give false evidence even to help an aiinicent person avoid jail.	82.25	±9.6	42.5	±10.7
7. One may send a cheat sheet during a competitive examination to a close friend	8.0	6.8	62.0	±10.1
8. One must not send a cheat sheet during a competitive examination to a close friend	90.3	±7.4	37.5	±10.3

respective self-awareness and image of the other are represented by the folowing formula[17]:

$$\frac{a}{\overline{\underset{a}{a + \overline{b}}}} + \frac{b}{\overline{\underset{b}{b + \overline{a}}}}$$

In English: *A* and *B* are in conflict. Both of them reflect this fact correctly, and both have incorrect images of each other and of themselves, *A* sees his partner as seeing *a*, but *A* herself sees *a*, so she believes her partner is wrong. *B* sees his partner seeing *b*, and *B* himself sees *b*; so he thinks his partner has a correct image of him.

Enter decision maker with a conscience

The behaviorist's model of an individual can be conceived as an automaton receiving inputs and responding with outputs, whereby the relationship between the inputs and the outputs is determined by "conditioning," resulting either from experiences induced by the environment or systematically imposed

by an experimenter. Lefebvre's "individual" can be also likened to an automaton receiving inputs and spewing outputs but with a fundamental difference. Namely, an inner structure is represented by a mathematical formula consisting of multilayered Boolean expressions (see above), which determine various algorithms connecting input to output. It is this structure that is deliberately ignored by the behaviorist, who is interested only in the observed correlations between inputs and outputs (stimuli and responses) under various conditions. Lefebvre brings the determining algorithms to the focus of attention, for example, an individual's image of oneself, image of one's friend or enemy, or of the situation in which one finds oneself, as well as feelings of guilt, sacrifice, condemnation, etc.

Lefebvre called this inner structure "semantics"; I call it "psyche"; Tolstoy called it "conscience" and identified it with God, whom Tolstoy removed from heavens and inserted into the human heart, having stripped God of all the properties assigned to Him by scholastic Christianity.

Mathematical psychoanalysis

In Lefebvre's model of the human individual, categories such as "suffering," "guilt," "doubt," or "condemnation" are defined formally as structures of awareness at different levels. For example, an individual may *doubt* the correctness of his images; *suffer,* when faced with a bad situation, *feel guilty* when she sees her own image in the state of evil. She may *condemn* her partner, if she sees his image in the state of evil.

Among the many applications of this apparatus, is '"algorithmo-psychoanalisis" of central personages in classical or propagandistic literature. Lefebvre selected Hamlet, the Shakespearean personage best known and most discussed in Russia. Hamlet has correct images of himself and of his uncle Claudius, suspected of having murdered Hamlet senior. But what makes Hamlet emphatically Hamlet is that he doubts the correctness of his images. This description can be clearly expressed by the Boolean algebra algorithm both in the first and in the second ethical system. Accordigly Hamlet's, as well as Claudius' ethical status can be calculated in both systems and compared. In the simplest case, the commands from the environment to do good or evil are given with equal probabilities $p = 1 − p = 1/2$. In this case the ethical status of an individual can assume just three values: 0.5 (low), 0.75 (medium), or 1.00 (high). It turns out that in the first ethical system, Hamlet's status is medium and Claudius' low. In the second ethical system both have the same status. Here Hamlet turns out to be a "hero of the second sort" in the second ethical system, whereas in the first ethical system, he is one of six "ideals" implied by the formal structures.[18]

The genre of propagandistic fiction was developed in the Soviet Union soon after the October Revolution. The most conspicuous example was Ni-

kolay Ostrovsky's novel, *How Steel Was Tempered*. Ostrovsky fought the Whites in the civil war, was blinded and paralyzed at the age of 26. For three years he dictated his famous novel with its idealized hero Pavel Korchagin, who became a shining role model of Soviet youth. His Korchagin had correct images of himself and of his enemy and doubts about the correctness of his own image. He did not, however doubt his image of his enemy. This Korchagin, attained the maximum ethical status. Thus we find in Soviet literature the "positive fanatic," - the ideal of the second ethical system [19].

Considerably more inolved and, in my opinion, more profoundly enlightening is Lefebvre's analysis of characters that have become proverbial through the works of Dickens, Balzak, Thomas Mann, Ibsen, Orwell and many others. In particular, Lefebvre singles out the "saint," the "hero," the "opportunist" and the "hypocrite." He sees the saint and the hero as "sacrificial" individuals, the opportunist and the hypocrite as non-sacrificial ones and produces the charcteristies of each as a member of the first or the second ethical system. For example, the "saint" in the first ethical system is non-aggressive, has low self-evaluation; in the second ethical system he is aggressive and has low self-evaluation. The hero is non-aggressive in the first ethical system and has a high evaluation of himself but, as expected, aggressive in the second ethical system and has a high opinion of himself. The opportunitst tends to be aggressive in the first ethical system and has a low self-evaluation, nonagressive in the second and also a low self-evalutation. The hypocrite is aggressive in the first ethical system, non aggressive in the second. Both have a high self-evaluationion.

The most detailed and interesting analyses of this sort offered by Lefebvre are those of principal charcters in Dostoevsky's novel *Crime and Punishment* [20] The central figure is Raskolnikov, the murderer, who is obsessed by both philosophies (ethical systems), Lefebvre points out: "Both personalities of Raskolnikov are sacrificial. The murder of an old woman is a special *sacrifice* of a person belonging to the second ethical system...The second personality sacrificially repents on bended knee."

Sonia Marmelodova, who becomes a prostitute to feed her family, is protrayed as the conscience of Raskolnikov's first personality. Svidrigailov, according to Lefebvre is a mysterious villain, possibly a murderer and a seducer but with largesse and nobility. Finally, there are Luzhin and Lebeziatnikov, both non-sacrificial, the former belonging to the first ethical system, the latter to the second.

Is rationality a platonic category?

At the outset I raised the question to what extent and under what circumstances definitions could be challenged as non-informative, ambivalent, or simply meaningless. In particular, I was thinking of value-laden concepts of pla-

tonic philosophy or Christian theology - justice, tyranny, wisdom, sin, redemption, etc. I argued that it is futile to seek the "true essences" of these concepts and others that arose only in the human psyche unlike concepts fundamental in, say, the physical sciences (energy, momentum, neutron, valence, etc.), which, one can assume, had referents long before we came on the scene of existence.

In paricular, some of Plato's "ideals" can be said to "exist," others cannot. I can't imagine "existence" in whatever sense, of "an ideal husband," or "an ideal city," or "an ideal sword." But I can easily imagine "existence" of an ideal pyramid or dodecahedron or sphere, namely in my imagination. I can also assign meaning to the paradox said to have been pointed out by Moses Maimonedes (a Jewish XIII century scholasticist) that the diagonal of a "perfect square" exists geometrically but not arithmetically (if one denies existence to "irrational" numbers.) Recall that the Pythagoreans prohibited under pain of death disclosing the incommeasurabillity of the side and the diagonal of a perfect square.

So how do things stand with respect to "rationality"? From what has been said about the development of decision theory (to which rationality appears to be closely related), it aparently deserves to be included in "existing" categories, as are the ultimate laws of nature, of mathematics, and of logic, but only in case the definition of rationality extends beyond the intellectual horizon *of homo economicus.* Recall the bizarre portrait of the "rational" voter, who calculates the "marginal utility"(!) of voting in a particular election. This portrait struck me as a caricature of rationality. Compare this voter with one who says she chooses to vote, because she considers voting a citizen's duty. Evidently she subscribes to "evidential" decision theory. The fact that she votes is evidence that she is a good citizen. From Lefebvre's point of view, her decision can be expressed defining her self- image and thus contributes to the evaluation of her ethical status. This rationale is totally absent from the psyche of the homunculus, for whom probability, marginal utility, and related concepts are self-explanatory.

The roots of reflexion in Antiquity

Recall the four types of men mentioned in Hebrew philosophy, all expressible in the language of reflexion.

"He who knows not and knows not that he knows not is a fool - avoid him. He who knows not and knows that he knows not is simple - teach him. He who knows, but knows not that he knows is asleep - wake him. He who knows and knows that he knows is wise - follow him."

It is interesting to note that both Thales, the first physical philosopher and Socrates, who is sometimes regarded as Plato's mouthpiece, spoke the language

of reflexion. The former's best known aphorism is "Know thyself," the latter's "I only know that I know nothing." The last is a clear illustration of one of Lefebvre's theorems derived from his Boolean algorythms: "A perfect individual cannot consider himself perfect."

NOTES

1)   Savage, L.J., *The Foundations of Statistics.* New York: John Wiley and Sons, 1954, Ch. 2.
2)   Blaise Pascal (1623-1662) shares with Pierre de Fermat (1601-1665) the laying of foundations for the theory of probability.
3)   This is what happens in Pushkin's weird novella, *The Queen of Spades.*
4)   Nicholas Bernoulli was Daniel's cousin, but Daniel refers to him as his uncle, possibly in deference to his age.
5)   Supposing utility inversely proportional to gain, we have $du/dt = a/t$, hence $u = a \log t +$ constant.
6)   Downs, A. *An Economic Theory of Democracy.* New York: Harpers, 1957, pp. 215-16.
7)   Joyce, J.M. *The Foundations of Causal Decision Theory,* Cambridge, 1999.
8)   The name was given to the game by A. W. Tucker. Two men are arrested. There is not enough evidence of burglary, but there is of possession of stolen goods. The situation is explained separately to each. If both confess, the normal sentence for burglary is reduced. If neither confesses, they are convicted of the lesser charge (possession of stolen goods), which is punished by a short term. If only one confesses, he goes free, while the other serves the full term.
9)   Diekmann, A. "Cooperation in an Asymmnetric Volunteer's Dilemma Game." *International Journal of Game Theory* (1993) 22: 75-85.
10) Darley, J.M. and Latane, B. "Bystander intervention in emergencies. Diffusion of Responsibioity." *Journal of Personality and Social Psychology* (1976) 8: 3 77-83.
11) Diekmann, A. Opus cit. 77-78. Alternatively, k (swimming skill) can be considered an investment (cost of training, etc.), which the father, who invested most, is most reluctant to risk. This is the way the result looks to *homo economicus.*
12) Brennan, D.G. "Review *of Strategy and Conscience* by A. Rapoport. *Bulletin of the Atomic Scientists (} 965) 21:* 25-30.
13) Kahn, H. *On Thermonuclear War* (1960) Princeton: Princeton University Press (p.29).
14) Hofstadter, **D.R.** *Metamagical Themas* (1985) New York: Basic Books (758-59)
15) Lefebvre, V.A. *Algebra of Conscience* Second Revised Edition (2001) Dordrecht: Kluwer.
16) Ibid. p. 42
17) Ibid. p. 54.
18) Ibid. pp. 83-84.
19) Ibid. pp. 86-87.
20) Ibid. pp. 118-25.

INTERNATIONAL RELATIONS

AMERICA'S IMAGE IN THE RUSSIAN NATIONAL CONSCIOUSNESS AND RUSSIAN-AMERICAN RELATIONS

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The contemporary strategy of national security of the Russian Federation in its most general form is a result of perception and conceptual comprehension of the Russian society's role and place in the world by its political and intellectual elite in the context of the occurring cardinal changes. At the same time the conviction of the Russian exclusiveness acts as the paradigm.

An important position within the system of paired «us-them» categories of the national consciousness, with those determining the perception of Russia's security, is occupied by the image of the United States. Being interpreted in the consciousness of the elites, that image renders its influence on the psychology of Russian-American relations. Actualization of that influence is connected also to the fact that US activities are already taking place directly in a space, which is a part of the space of Russian historical culture in Eurasia. That circumstance sharpens the feeling of a direct threat to Russia's interests and security and induces to take responsive actions.

Irrespective of the US policy one should admit that the appearance of the USA (as well as other states) in Eurasia is a quite predictable phenomenon in the conditions of globalization and growing interdependence of countries and peoples. At the same time one can see that by their behavior and psychological reaction some Russian political and intellectual elites demonstrated that they are not yet ready for a drastic change of Russia's relations with the outside world. In particular it was discernible that the USA was evaluated to a large degree according to the stereotypes that took shape at the previous stage of development of international relations.

The Russian society's contemporary negative notions of the United States were formed during the Cold War period. At the same time one should note

that the initial perception of the USA was different. It was taking shape at the time of mass settlement in the two Americas. It was then that a myth about America as «a land of boundless opportunities», where a relatively fast achievement of material well-being was possible, was formed in the world. But in the myth about America there is something more than just the aspiration for material welfare. The discovery of America created an opportunity to achieve «the supergoal» that was born deep within human consciousness and universal for all peoples and to realize «the most cherished desire and the deepest dream and hope the Holy Kingdom... on Earth and for Man a strong hope for that state of grace to be brought as close as possible (or even open itself, to come) in space and time...» [1].

That discovery was interpreted literally as the discovery of «the desirable shore of freedom», causing the opening of an opportunity to achieve the supergoal.

A mass resettlement across the ocean started in the atmosphere of such ideas. Russians as well were resettling there. Everything began with the discovery of their own Russian America, which was a continuation of Russians' development of the «ukraine» («frontier») lands in the East. Russians' movement to the End of the Earth was determined not only by the economic expediency [2].

It was an age-old aspiration for truth behind the thirty nine seas and a search for the Promised Land where our ancestors hoped to find their ideals and to realize their yet non-comprehended personal basis that's the freedom of choice. Simultaneously the eternal process of human myth-creation and the endless cognition of one's Me was taking place there.

The discovery of America was closely connected with one might call «the islandic theology» of the Russian Orthodox Christianity. «Its central contents were briefly portrayed as the picture of future humankind and transformed world...» [3, p.79]. Therefore some thinkers interpreted the meaning of the discovery of America as «Transfiguration» the search for that, «which would be beyond the history, beyond the earthly pilgrimage of humankind..., which is the goal of the process of deliverance, that is transfiguration of the world..., which the Greek Fathers of the Church called the theosis, the deification of the world» [3, p.85]. The idea of «Transfiguration» is «the central icon-symbol of the historical development of the spaces of midnight lands» by the Russians [2, p.41]. The location of America «behind seas and oceans» only increased its image as «an island of Deliverance», a kind of «otherworldly world», a Heavenly City a new Jerusalem on Earth.

Russian elites were aware of the political events occurring across the ocean. As early as five years before the publication of Tocqueville's book «On Democracy in America» (1835), which was very popular in Europe in the 19th century, a well-known Slavophil I.V.Kirievsky (1806-1856) tried to express his atti-

tude to the American experience [4]. He believed that only two great young peoples existed within the framework of European culture: the United States of America and Russia. That thought took quite strong roots in the Russian consciousness. In 1841 in Slavophilically-oriented «Moskvityanin» magazine an author argued precisely that the United States and Russia would come to replace «dying» Europe [5]. According to his contemporary, Pushkin, the progressive circles of Russia had developed «a respect to this new people and its structure, [which is] a fruit of the newest enlightenment» [6], but also a critical attitude to some peculiarities of its social life, slavery in particular.

Russians did not just watch. They directly participated in revolutions, liberation movements and the Civil War in the American continent, wherein they tried to realize their protest against the Russian reality that oppressed them. And the image of America in Russians' eyes was the antipode of old Europe too.

Political thought in Russia constantly tries to comprehend the American experience. For example, Slavophils, as well as members of «Slavic Society of Saint Cyril and Saint Methodius» in Ukraine were preparing a project of creation of a confederate union of all Slavs similar to the North American States. The Westernizers, as well as Russian Social Democrats, who were elaborating a concept of building Russia on the basis of federalism, also used to turn to the American experience.

A transformation of America's image took place after the change of social structure and ideology of national development strategy of Russia in connection to the advent of leftist radicals Bolsheviks to power. The new Russian elite broke ties with the traditional national identity and proclaimed the cult of transnational superidea. Since then the two powers total confrontation began. And first of all that was the clash of two superideas. By that time the USA had already undertook a global mission of struggle against empires for the sake of assertion of their notion of freedom in the world space. The alternative project was worked out in the Soviet Russia: transformation of the world on universal socialist basis. Thus, the USA was challenged.

As the US might and their influence in Europe grew, public consciousness of Russia-USSR began to perceive America as the symbol of the West «the world of capitalism» and the external threat in general. The United States became the leading, although negative reference-point in the development of national consciousness of Russia's people, while the ideology of anti-Americanism continued the tradition of direct opposition of Russia to the West. Thus, essentially very productive idea of alternate or parallel civilizational development, proposed by Russian socialists, but brought to absurdity by their Soviet successors, in the end returned Russia to the position of the one trying to catch up, with all complexes inherent to it. That was the psychological context in which Soviet-American relations were developing.

After the end of the Second World War, each of the two superpowers claiming to have made the main contribution to the cause of defeating Nazism, laid their claims now to the absolute world leadership, at the same time expressing mutual distrust and dislike. The infamous Cold War began, being a clash of not so much interests, but rather myths of the USSR and the USA. Besides, the nature of the Soviet-American relations was influenced by internal contradictions inside each country, when subconsciously and consciously attempts were made move tension from domestic national space to the external one, when each hostile party created and nurtured the image of the enemy.

Both states were asserting themselves in mutual confrontation. Special elite groups took shape in a natural way, whose interests were directly based on mutual Soviet-American struggle. It's obvious, that the outcome of the rivalry was to be predetermined not only by the viability of the national socio-political systems, but also by the correlation of the rational and the irrational in the national consciousness of both peoples.

For the post-Soviet Russia America remains the most important reference-point of the national consciousness. Everything is entangled here: clash of real and false interests, geopolitical rivalry, jealousy and grass-root envy, anti-American rhetoric and indestructible desire to see one's country similar to the USA, to share its evident successes, subconscious wish to imitate it in the state structure and way of life. At the same time the internal rejection of the American experience is one of the reasons for the lack of skills in using it for one's own good.

The contemporary problem of national reflexion seems to be the question how to solve positively the conflict emerging from combination of the initially formed positive perception of America as the Promised Land and the exiting reality of the balance of power changed in favor of the USA. Lack of understanding of that change is linked to the danger that Russia might again get stuck in a new counterproductive mutual struggle with the USA. And, the other way round, understanding of some psychological specifics of formation of US national security strategy opens for Russian elites an opportunity to elaborate a strategy of containment of global US expansion and overcoming the inferiority complex itself.

The US society is known to have been formed from outcasts, the main reason for their moving across the ocean being misfortunes in their motherlands. From the view-point of social stratification, those outcasts belonged to peripheral marginal groups, to whom, as Stonequist believes, inferior identity is inherent; a certain alienation from their own culture and an uncertainty in belonging to their new country's culture. For some time that "reflects in the psyche of an individual, who becomes a dual personality, that is a person possessing a dual consciousness" [7]. But one should also take into account that such personality has a strong internal potential for self-assertion. Many outcasts real-

ized that potential, thus laying down the initial basis of American mentality. The resettlement across the ocean meant challenging not just one's fate, but the Old (!) World, its complex structure of existence burdened with many traditions already of no use to the future American. An outcast «left behind all his old prejudices and manners and acquired new ones from the new way of life… An American is a new man who acts according to the new principles, therefore he must adhere to new ideas and work out new views» [8].

Each new generation of immigrants threw a challenge to the old life and old Europe. Thus, on the one hand, the Americans' assertiveness grew stronger. But, on the other hand, the nation each time found itself somewhat in the state of uncertainty and self-assertion, if one were to proceed from the above-mentioned specifics of a marginal re-settler.

In the words of well-known American historian Schlesinger, Jr., the US foreign policy is the face of the nation [9]. And that irrational aspect of an America yesterday's outcast is reflected in it. The scale of migration flow to the USA has bee so significant, that the process of permanent "rejuvenation" of the nation has become a substantial factor rendering its influence on the Americans' perception of the outside world and a stimulus for the external expansion. The above-mentioned state creates a certain psychological background of US policies. In other words, to a large extent the respective generations of immigrants and nor rarely specific persons stand behind various steps in US foreign policy, A parallel can be drawn here with Russia: the expansionist basis of well-known doctrine of unification of Slavs was born in the head of Croatian refugee Yu.Krizhanich.

The ideology of US global policy took shape, when American help and «nuclear umbrella» of security was offered to war-torn Europe. At that time notions took root in American consciousness that, allegedly, positive results were achieved thanks only to the qualities of their national model. As Americans themselves acknowledge, the post-war «growth of American might strengthened» their messianism, their «faith that America's God's chosen one» [9, p.83]. Moreover, the American ideology is already considered something entirely universal and capable to transform the whole world. Thus, promotion begins of not only American interests, but American way of life as well.

In the end, US policy of assertion of liberal values and struggle against European and Asian imperialism has been transformed to such degree, that the USA themselves become similar to an empire. That is they acquire its typical features of non-constructive imposition of culture, messianism and great power's ambitiousness.

Thus, the US foreign policy in Eurasia has been shaped under the influence of two factors: pragmatic attitudes of an American's national character (that has been manifested in the theory of political realism) and subconscious

overcoming of a marginal immigrant's complex by means of imperial messianism.

The first one gives reasons to suppose (or believe) that the global domination literally cannot be the US goal, as to achieve such goal would require huge costs and resources and that in the end would entail a growing resistance on the part of the other subjects of international relations. Besides, such policy would contradict the spirit of American liberalism and deeply inherent sentiments of an islander. While the second factor caused by the presence of a significant number of first-generation immigrants in the US society stimulates imperial expansionism.

The above-said does not mean that there are some absolute reasons for the following type of arguments: the imperial basis in its absolute expression is the sole content of the US international policy. As A.Schlesinger, Jr. admitted, «In the end the reasons of national interest limit messianic passions» [9, p.89]. But that depends also on the internal state of the American society at any given moment of its development. At present, similar to the Russian society, it lives through a change in reference-points. One of the major ones, Communism, personified by the Soviet Union has left their number. And together with that an important factor of mobilization and identification of American political elite has disappeared. The loss of support leads to an involuntary aspiration to intensify the foreign policy as a means of relaxing the domestic tension.

Russian at present faces the next challenge on the part of the USA in their capacity of not the state, but that of a special civilization, a system-creating element of the Euro-Atlantic civilization. At the same time Russian elites excessive focusing on the image of the USA as the key enemy in the international relations are overcome slowly and with a great labor, distracting from the most important issue. Namely that is the problem of working out the cultural reference-points, which could be able to consolidate the society and mobilize it for a strategic breakthrough. That means that the strategic leadership is ensured not by defensive or offensive stances in foreign policy, weapons of vengeance or containment, but by ideas freely competing with each other. It is precisely those that create not only weapons (if someone still needs that), but also more importantly an effective economy.

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REFLEXIVE TECHNOLOGIES

PECULIARITIES OF REFLEXIVE PROCESSES IN RELIGIOUS WORSHIP ORGANIZATIONS

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The problem

Since the 1970s, it has been a widespread opinion in the society, according to which, the so-called "totalitarian" sects (religious cults) are the social evil. The leaders and the agents of influence of these cults are blamed for "thought control" [6].

The religious worships practiced by totalitarian sects are most widely spread. However, one may reliably assert today that any sphere of human activity, be it religion, pedagogy, politics, leisure or hobby, provides its particular pattern of cult groups or movement.

Consider one of many contemporary descriptions of a cult [10, 13].

"A cult is to a large extent a group, or a movement that:

(a) demonstrates an outstanding or specific devotion to a certain person, idea or thing;

(b) engages a thought-reforming program to persuade, control, and prepare newcomers to the group life (i.e. incorporate them into the unique group model of relationships, faith, values, and practices);

(c) systematically stimulates states of psychological dependence in the members;

(d) exploits the members in order to successively reach the goals set forth by the leaders;

(e) inflicts moral damages on the members, their families and society."

Attempts to regulate the activities of totalitarian sects by legislative measures (prohibitions, limitations, etc.) often come across insurmountable obstacles. Unlike in the circulating rumors, no barbed wire or armed guards would be found around the settlements of sectarians. In many cases, there is no charismatic leader that would lure the youngsters into changing their lifestyle. Moreover, contacts with the leader are very often practically forbidden to sectarians (e.g. the Reunion Church, "the Munists"). A newly converted member usually does not remind of a zombie. No mass hypnosis is used in the overwhelming majority of cases. Actually, the techniques of psychological influence used to rapidly convert the people into a new faith with long-lasting effect appear to be routine psychological methods providing high efficiency with their combined action and application to the people whose social relationships are either weakened or underdeveloped.

An attempt to work out a legislative act in France which would regulate sectarian activity provides a vivid example or irresolvable problems arising as a result. Not only sectarians, but also representatives of traditional confessions vigorously protested the draft aimed at certain particular features reflecting asocial character of activities of the sects.

One may understand such a reaction considering according to the widespread opinion in order to qualify a group or a movement as a sect, the existence of one of the ten following features is sufficient:
- destabilization of consciousness;
- overdue participation fees;
- imposed cutoff with the previously established social environment;
- attempts at physical health;
- recruiting children;
- antisocial statements;
- violation of social order;
- prosecution of members on serious accusations;
- violation of economic activity regulations;
- attempts to penetrate into the state bodies.

The problem looks even more acute given the fact that the psychological technologies developed in religious worship organizations become widely used to the benefit of specific persons or groups at the expense of the interests of the society. Multiple examples of such misuse can be easily traced in political battles, informational-psychological warfare, international terrorism.

Taking as an example the so-called totalitarian sects, we shall further consider and generalize the bulk of methods of psychological influence used in religious worship organizations. To this end, typical mechanisms used by these organizations in their activities shall be considered in the context of organization of reflexive control. We suppose that such an approach will provide a new

opportunity for consideration of the activities of totalitarian sects as a social evil, as well as foster improvement of ethical and legislative regulations of such activities.

Life activities as the main objective of control in totalitarian sects.

The main purpose of any totalitarian sect is to impose on its members certain specific forms of life activities considered to be a norm of life for anyone who practices a particular cult. It is only in this case that the implicit obedience may be achieved and specific forms of business typical for totalitarian sects may be organized. A general scheme of control of life activities by the sects is represented on Fig. 1.
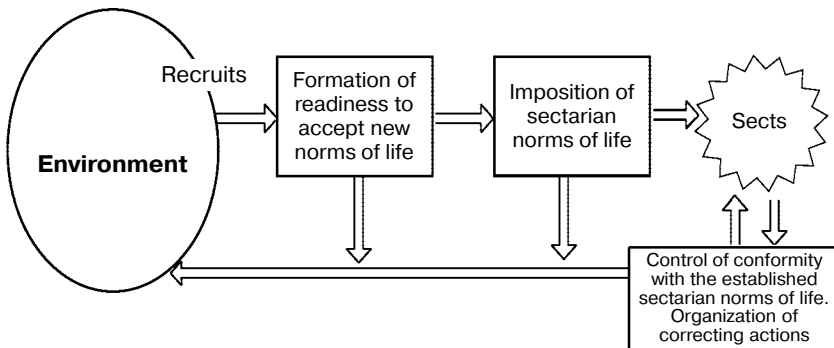
Fig. 1. A simplified scheme of control of life activities exercised
by totalitarian sects

Further we shall consider basic reflexive processes realized in the context of the above scheme.

Analysis of basic reflexive processes of control over members' life by totalitarian sects

Psychology discriminates between two modes [9] of existence of a human as a subject of life (life activities). The first one is life within the framework of immediate relationships into which an individual is emerged (this one may be called a "reactive" mode of existence). The second one is related to reflexion. Consciousness is a means of breakthrough, of going beyond the routine everyday life process in order to elaborate an adequate attitude to life, to gain an outside position to be capable to make judgments (a "reflexive" mode of existence).

Given these two ways of existence of a human as a subject of life, we shall further consider two extreme (from the point of view of good and evil to the society) versions of transition of a human to a new form of life activities. We

shall also assume that other people participate actively in these processes to support (control) the transition.

Version 1. *"The development scheme"*. The scheme generally comprises the following procedures:

– "*Cutoff with the established life activities (reflexive breakthrough)*": a state of readiness to accept new forms of life activities. An individual either becomes aware of the necessity to change his lifestyle himself, or someone suggests a new understanding.

– "*Actualization of reflexion*" as the only possibility to create, to choose consciously a new way of life activities as well as to arrange the process of transition. Outside help is very important in this procedure as the "reflexive breakthrough", going beyond the limits of one's own life activities, making one's life a subject matter of consideration, comparing it with the new way: all of these are extremely complex processes requiring engagement of means and methods other than have been used in the routine everyday life.

– "*Reflexive cooperation*": a support to a person making "a reflexive breakthrough" to gain a new life position. Such help is a focus of contemporary humanistic psychology as implemented in psychotherapy, in organizational development [12], in the development of activities based on modern information processing technologies [5], in organization of political activities, in management consulting and other types of support to human activities. These approaches are oriented toward personal freedom. Imposition of any "recommendations" and "advice" from outside is excluded.

An individual implementing "the development scheme" is a true subject of development of his/her life activities. He is in the process of development as the "actualization of reflexion" procedure either provokes transition from the reactive mode of life to the reflexive one, supports the reflexive mode of life providing new means of efficient functioning. One may say that "the development scheme" is the good for the society as it is oriented toward a free developing person.

Version 2. *"The reflexive programming scheme"*. The scheme generally comprises the following procedures.

– "*Cutoff with the established life activities*" (see: Variant 1).

– "*Reflexive blockage*" blockage of "non-sanctioned" reflexive processes, deprivation of a possibility to create or consciously choose a new form of life.

– "*Social isolation*" blockage of "non-sanctioned" informational-psychological influence of social environment (family, friends, colleagues, etc.) on the processes of creation or conscious choice of a new form of life.

– "*Reflexive programming*" imposition of predetermined notions, points of view, positions, opinions and other psychological formations in order to shape conscious acceptance of the intended norms of life. The one who "predetermines" (the sect leader, the authoritative guide, etc.) seeks to gain an overwhelming control over members' minds.

Table 1 illustrates the essential differences in orientation between "the development scheme" and "the reflexive programming scheme".

Table 1

Essential differences between "the scheme of development"
and "the scheme of reflexive programming"

Aspects compared	Scheme of development	Scheme of reflexive programming
Orientation toward the mode of human life	Oriented toward the reflexive mode of human life activities	Oriented toward the reactive mode of human life activities
Attitude toward the subject	Oriented toward protection and formation of human "subjectivity"; manipulation with humans is excluded	Oriented toward conversion of a subject into a subject of control; socialization by internalization of a cult organization norms plays the leading role
Actions in specific situations of life activities	Oriented to autonomous actions in any situation of life (problem-oriented approach)	Oriented to prescribed action patterns in typical situations and relying on the sect leader's help in outstanding situations
Leading directions of psychological influence	Stimulation and support of reflexive processes	Blockage of reflexion; blockage of social contacts outside the sect; reflexive programming; learning and mastering ideas is based on emotional acceptance; critical analysis excluded
Structure of control	Flexible "horizontal" structure of control	Rigid "vertical" hierarchical structure of control
Basic knowledge	Procedure	Object-oriented
Preparation of a subject to life activities	Formation of basic qualities oriented toward independent organization of one's own life activities	Teaching knowledge, habits and skills necessary in practicing methods and implementation of normative notions of the cult organization

When "the scheme of reflexive programming" is used, an individual becomes an object of control. The procedures of "Reflexive blockage", "Social isolation" and "Reflexive programming" consolidate the "reactive" mode of life activities and by no means support development of personality. This scheme clearly puts limitations on personal freedom. One may state that "the scheme of reflexive programming" is a social evil as it is oriented toward making a robot out of a human.

We shall further demonstrate that *the totalitarian sects practice exclusively "the scheme of reflexive programming"* and shall try to prove this demonstration with the results of analysis of the methods of psychological influence they use to put into life all the procedures envisaged by the scheme.

Examples of reflexive control techniques practiced by totalitarian sects

Techniques of implementation of "the reflexive blockage" procedure:

1. Use of physiological mechanisms: reduction of consumption of food reach in proteins and reduction of sleep make a human liable to persuasion.
2. Frequent repetition of meaningless word combinations or unlimited pronouncing of prayers reduces human's resistance to manipulation.
3. A newly converted is required to be faithful and to accept ideological and theoretical principles without criticism. Gradually these demands grow up to develop in the novice an overwhelming devotion to the group, its leaders and its ideology.
4. Imposition of patterns of perception. The leaders of the sects teach their flock how to counter any objection and answer standard questions.
5. Imposition of a viewpoint according to which joining the sect allows one to solve all personal problems, find a way to success, arrange a truly worthy life. An individual is persuaded to voluntarily delegate his personal function of reflexion to the group subject, i.e. the sect. Thus a psychosocial dependence on the sect is established and, in the long run, personal freedom is lost. This phenomenon was outstandingly demonstrated by the People's Temple sect (founder Jim Jones), the leader of which managed to arrange an act of mass suicide "volunteered" by 913 people including over 200 children [3].
6. Negative estimation by sectarians (agents of influence) of any statements or actions of the recruited or converted that contradict the dogmatic notions shared by the sectarians.
7. Selection of people pre-disposed to the reflexive blockage. Analyzing the phenomenon of "escape from freedom" E. Fromm [11] describes a psychological type incapable of meeting the challenge of freedom: the world seems "dangerous" to such an individual, and "escape" into stereotyped life occurs.

Techniques of implementation of "the social isolation" procedure:

1. Monological influence: all other sources of information (mass media; parents; friends) are pinpointed as "devilish"; thus unidirectedness of influence is achieved.

2. Selection of audience: the selected are as a rule the people with disrupted (trouble in the family, etc.), or underdeveloped (teenagers) social relationships [8].

**Techniques of implementations
of "the reflexive programming" procedure:**

1. Exploitation of the reflexive formations already established.
2. Poly-subjects reflexive control (exercised by the group subject).
3. Distortion of positions of the agents of basic reflexive structures of consciousness.
4. Engagement of subjects of basic reflexive structures of consciousness.

Exploitation of the established reflexive formations
(examples are from [4, 8])

– Use of universal mythology: the leaders of sects proclaim themselves messengers of the new advent of the god to earth, thus initializing the existing reliable mythological schemes.
– Attributing the rank of the Holy Script to contactor-medium "messages" or "reports". Citing messages as Holy texts. This is based on integrated misunderstanding by the sectarians of what the Holy Script is and of the difference between the prophets and hermits on the one hand and modern "contactors" on the other.
– Distortion of ancient teachings, attributing impertinent qualities to them.
– Introduction of Satanist views (often as ambiguous vague images and symbols) under the disguise of esoteric knowledge: freemasonry, German national-socialism, etc.
– Perversion of emphasis of one or several doctrines of world religions; raising the secondary assumptions to the level of exceptional importance, the "quintessence": the Our Lady Center, groups of theosophists, extrasenses and parapsychologists.
– Total restructuring of one or several religions doctrines. Sometimes it is the "Orthodox Church" in Petya Ivanov's interpretation, or "Buddhism" as interpreted by Molly Smith: the Brahmakumaris University, numerous Western sects.
– Reduction of an original doctrine to total loss of its initial spiritual content and multidimensionality: Western sects, the most radical Pentecostal worshipers.
– Working out and reproduction of new rituals of doubtful value and esoteric or bioenergetical content: Western sects, masons and other secret organizations.
– Overemphasizing the facts of distortion of the Holy Script ("everything is distorted there, we are the only people who know the truth!"): the

Our Lady's Center; the majority of theosophical groups; the Brahma-kumaris.

– Non-critical acceptance of one's own visions; taking symbolic of other subjective perceptual images for seeing the High Truths of highest universal value: the Agni-Yoga by E. Roerich; practically all extra-senses, contactors and mediums; the teachings of the Our Lady's Center.

– Overt charlatanism and petty mystifications of the profanes, most frequently by use of grotesquely simplified astrology and by reference to the sphere of past incarnations: "home-made" astrologists including the majority of relatively non-dangerous rascals.

Poly-subjects reflexive control (by a group subject)

– The influence always takes place in a group where a person will automatically imitate the "correct" behavior of other sectarians including specifically oriented agents of influence: this technique is used practically by all totalitarian sects.

Distortion of positions of the agents in basic reflexive structures of conscience

– Intentional lowering of significance of Avatars, or World Saviors; their interpretation as "simply very good guys of high morals, so rare in those days".

– Substitution of the intelligent for the spiritual. Description of the spiritual visionaries and prophets of the past and/or present as philosophers, or otherwise, interpretation of philosophers as the only carriers of spirituality: all new schools of development (dianetics, rebirthing, the majority of parapsychological groups).

– Lowering the significance of the immediate social environment (family members, friends, co-workers, etc.).

Engagement of subjects in basic reflexive structures of consciousness

– Introduction of mediums and contactors into the internal clerical hierarchy: the Our Lady's Center; the Brahmakumaris, all groups of contactors [4].

Evaluation of activities of totalitarian sects from the viewpoint of ethics and law

When ethical and juridical aspects of the activities of representatives of totalitarian sects are considered, two questions are usually attract the focus of attention [3]:

1) Is it true that an individual may be deprived of freedom of resistance or escape under the conditions clear that menace or physical limitation of freedom are absent?

2) When does the "typical and common" psychological impact trespass the limits of the norm, becoming "a forbidden trick", or go beyond the average level of psychological resistance?

In our opinion, the above considerations on the set of mechanisms of reflexive control typical for different totalitarian sects allow us to get closer to realistic answers to these questions.

The answer to the first question, obviously, should be positive. The analysis of activities of totalitarian sects testifies to such a conclusion. In their extreme manifestations, certain techniques of psychological influence on the sectarians, without any physical violence or menace, may lead to mass suicide. The results of our analysis of mechanisms of reflexive control show that totalitarian sects use highly elaborated and extremely efficient psychosocial techniques. To resist or avoid impact of such techniques, an individual (object of influence) should either be specially trained, or should have consolidated social relations, especially with the immediate environment.

In seeking the answer to the second question, experts and researchers usually focus their attention on cases of deception and psychological influence techniques used as means of conversion, as well as on inflicting emotional and moral damages, deprivation of freedom of movement. Judging by the experience, this approach comes across the problem of forbidden interference with the freedom of religious worships and preferences. The court usually takes the sectarians' side so far as they enjoy the freedom of expression of their beliefs and, similarly to representatives of other religious confessions, seek to recruit new members.

Consideration of the mechanisms of reflexive control used by totalitarian sects opens new perspectives in search for symptoms of social evil in the activities of totalitarian sects. The attention should be focused on the system of psychological pressure used to impose on members of society the norms oriented toward organization of new forms of business and toward exploitation of the citizens by sects.

On the whole, complex criteria should be worked out to evaluate the activities of totalitarian sects. These criteria should be sensitive to all the considered mechanisms of organization of reflexive control used to impose a-social norms of life.

A case study of a sample of literature of a totalitarian sect

The sample considered is a book by Archbishop Ioann, the leader of Our Lady's Center sect, entitled "The Flame of Repent" ("The orthodox Church of Our Lady the Powerful" edition, 2000, 70 pages). The book is addressed to the newly converted sectarians and is aimed at the most important func-

tion of the believer, the penance, that *"pre-supposes invisible transfiguration of our thin body"* (p. 3). The mechanisms of reflexive blockage are initialized right from the very beginning. They are aimed at secret suggestion to the reader of focusing the consciousness of internal vision of his own and his parents' sin, feeling the sin and experiencing it, of cutoff with social activities. *"What is this long-suffering of ours to be manifested in? In non-willingness to build up anything on this earth". "The testament of the Holy Ghost is in the internal heart"* (p. 3).

The rejection of personal freedom of will is based on a statement that everyone has nether world in his soul: *"Mental light illuminates a hidden internal nether world secretly carried by your soul".* In other words, there is no place for the God's sparkle there. *"Our good deeds appear to be disgraced, charity is not welcome to God, as neither this nor that, or any other self-justifying prayer is agreeable with the Providence, and, consequently, do not lift the burden of the sin, not a jot." "Behold the sin in your soul and repent!"* (p. 4).

The mission is in a way assigned to the newly converted, that of praying out the sins of their parents, the sins which the latter do not comprehend, or do not wish to comprehend, and which would cause ordeals and death of their souls. *"The last Christians will be crushed down by their generic sins. They will have no other choices but to sacrifice or be ultimately ruined... Those coming to this world to suffer for the parents' sins will sacrifice to the altar of the Savior and become sacred."* This sacrifice by the one praying for the parental sin requires cutoff with the ancestors: *"The more sacrificial is the soul, the more lonely and painful, the closer it is to First Lamb and God's Mother"* (p. 4). *"Hard-heartedness is unavoidable when poignant and pathological old ties are being broken. Certain hardness to the father and mother provides a shield against the authoritative pressure. As any other evil, cruelty has a defensive character and is a result of psychological complexes. But such a temporary shield is better, no matter how poignant to both parties, than the vicious old relationship. With the time passing, when the cup is filled, the Lord will make the heart softer, and the sympathizing love will be given, which will be spiritual in the new nature"* (p. 13). *"The parental sins are grave... Above all, the parents should forgive, then comprehend the truth that the negative attitude toward them, hard-heartedness and animosity, do not reduce their sinful parental cup, but represent the other extreme of love and attachment. That is why you are blessed to break the internal ties and, by true internalized confession under the sober guidance of the confessor, realize the burden of sinful heritage and repudiate it."* Further actions will be suggested by the confessor: *"One is supposed to leave home, another one, on the contrary, should repent in front of his parents, the third one is supposed to begin his spiritual struggle, the fourth one to get out of the hypnosis"* (p. 22). The mechanisms of blockage of reflexion are clearly visible in such texts, which are thoughtfully constructed and look like invocations with minimal meaning and moral significance.

Intellectual activity and reasoning are represented as a grave sin: *"The time has come to understand the nature of reasoning, and to repent seeking for recovery from this dreadful sin... The recovery should be sought for in penance. A spiritual person perceives intellectual activity as an essence which is contrary to the soul, and reasoning as a justification of patent and latent sins."* This passage is followed by an exemplary prayer: *"God help me to exhaust myself in the name of Christ and to understand the damage of reasoning making dead the living tissue of the becoming an alienating the inner man from the nature"* (p. 6).

The reflexive programming is implemented rather roughly, through praising the proposed view and disparagement of all the rest. The traditional religions are rejected as outdated and insufficient, even treachery of the Savior: *"The old types of theologies (religious philosophies) are helplessly outdated. A new theology begins, the theology of living prayer, of staying before the cross, of the holy spiritual prophecy of penitential existence"* (p. 35). *"Today all the universe personified in the unworthy church has once again crucified Him"* (p. 24). In other words, the Our Lady's Church is the only true one!

It is asserted that the modern external world is a demonic mode of killing human souls: *"The Enemy seeks to confine the soul to the limits of the external order, which is an illusory mental paradise keeping the soul in spiritual blindness and lies. The means he uses are unlimited: science, arts, philosophy, drugs, etc. Any arrogant idea becomes his means. The devil even does not forbid prayers or false humility, zeal and pursuing the church..."* *"While the soul is arrogant and does not follow the way of the ultimate truth, it stays in the powers of demons. Once you try to hate yourself and wish to enter the spiritual order, all the nether world would rise..."* *"Before there is hatred to one's own self, the spiritual man has not been born"* (pp. 16-17).

Fixation on penance, on feeling sinfulness of the internal and the external world of the newly converted, is the main technique of narrowing the consciousness and isolation from the society. It is asserted that *"Penance is the highest art and science, it should be laid into the beginning of a new epoch. All the rest should be rejected as an illusion and the dream that ends up with the dreadful wakeup in the hell"* (p. 35). *"Deep personal penance leads inevitably to feeling the fault of the church, and the global feeling of sinfulness of the world, and further on a prayer for the world is given. Feeling one's guilt is a life-giving source of any prayer, in the absence of which the prayer dries out as a source in the absence of waters"* (p. 36).

Similar texts may be found in the literature of any totalitarian sect. They may differ in what may be called "theological content", but militant appeals to penance may be discovered practically in any kind of such texts.

Conclusions

Understanding the importance of countering the menaces the totalitarian sects inflict on the informational (informational-psychological) security of Russia, we consider to be necessary:

(1) To work out social technologies to initialize the reflexive mechanisms in Russia; to adopt as a stable and conscious norm, orientation of all members of the society toward the harmony of ethnic, confessional, regional, state, social and personal relationships; to stimulate various social relationships within the society, particularly, in the immediate environment of any individual.

(2) To create a system of informational-psychological security of Russia oriented towards the interests of a person, society and state in the process of formation of a civilian society.

(3) To re-orient the system of education from the knowledge acquisition to the development of reflexive abilities; to form a multi-level, multi-dimensional consciousness and the abilities of independent self-orientation in different situations of everyday life, in relation to history and culture; to consolidate the ethical systems providing for resolving conflicts as well as to make other steps to the improvement of education. The traditional education (from kindergarten to univesities) provides no sufficient means of protection of the people from the pressures exerted by totalitarian sects: numerous facts of conversion of well-educated people are the testimony of this drawback.

(4) To create efficient psychological technologies to help people that have fallen under the influence of totalitarian sects (break-off and rehabilitation) based on the "cutoff" mechanisms and the actualization of reflexion and providing for overcoming social isolation and for de-programming.

It is not the pinpointing of certain features, but the revealing of assemblages of technologies that may signal the negative impact of the sects on the society and a person. This approach will more adequately reveal the direction of such activities toward limiting the freedom of personality and formation of specific psychological dependence on the sects. This approach will also make possible to create the prerequisites for consideration of psychological dependence on the sects as a syndrom of a specific illness, similarly to the description of a syndrome of "cyberdependence".

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SCIENTIFIC STUDIES

REFLEXIVE PROCESSES IN CONTEMPORARY SCIENCE

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1. Pre-requisites of self-cognition in contemporary science.

The notable growth of self-reflexivity becomes a parameter of continuously growing importance in contemporary science. The concept of *reflexion* in a broad sense is known to apply to acts of self-conscience, self-cognition, self-estimation, i.e. something that may be called "thinking about thinking". The term "reflexivity of scientific knowledge" applies to the directedness of the knowledge to itself, to the availability of mechanisms and norms of conscious control of its growth and functioning [2, pp. 3-6; 9, pp. 448-449]. It is not a mere coincidence that these mechanisms have become activated in modern science. New studies in complex and self-organizing systems, transformation of science into a complex institution functioning as a factor of development of the society foster the mission of efficient organization and self-organization of the scientific knowledge that works out corresponding mechanisms realized by the functions of reflexion, i.e. coordination, orderly arrangement, criticism and regulation.

Analysis of reflexion in sciences should be aimed not merely at a certain "meta-level" of (scientific) conscience where refutation of the stereotypes of thinking occurs, but rather at a radically different viewpoint from which science and its development are considered in a specific respective prescribed by shift of the focus of attention from the object studied to the means of research, the tools of cognition and the activity of the cognizing subject. Implementing "thinking about thinking", and thus having seemingly theoretical significance only, reflexive procedures presuppose putting into practice follow-ups. Their strategic objectives, clearly being criticisms, imply a review of once universally acknowledged, but currently outdated activity patterns and revision of seem-

ingly self-evident assumptions that, when reconsidered, prove to be non-trivial and problematic.

It was as late as in the 1960-70s that the reflexivity of science came into the focus of ever growing attention. In the 50-60-ies "reflexion" as a philosophical category was treated by Soviet philosophy as "alien to the Marxist theory of cognition" [8, p. 13]. The Big Soviet Encyclopedia characterizes reflexion as "a term of bourgeois idealistic philosophy… The dialectical materialism rejects the term "reflexion" as a concept of the theory of cognition" [BSE, 2nd edition, vol. 36, pp. 423-424]. This approach to the problems of reflexion, however, could not be long standing because of the progress of science.

Science has always incorporated in its body a kind of self-conscience. However, before recently, the self-conscience had existed only as a sporadic reflexion of particular researchers that questioned assumptions of their disciplines and re-estimated, often re-shaped certain segments of knowledge to make it more orderly, precise, and to modify it [21]. Questioning often was the point of departure for an entirely new, generalized theory. This is a kind of "personal" form of reflexion that takes place within the limits of personal knowledge known to be intrasubjective, ideal, and detached from the object of cognition.

The immanent processes of development of science propelled primarily by non-classical tendencies restructure the research activities so that, together with the personal form of reflexion, *super-personal* (not extra-personal, however) forms of scientific self-conscience inevitably come to exist and become institutionalized. These forms are super-personal as they emerge as conceptually contoured structures aimed at studying qualitative and quantitative parameters of science, of separate theories and concepts to draw a general picture of science. These forms are super-personal also in the sense that the branches of knowledge most clearly expressing the self-conscience of science, i.e. scientology, scientometrics, sociology of science, are relatively autonomous both as cognitive and as institutional systems. The knowledge they produce is inter-subjective, detached from its creator and coded in symbolic systems. Personal knowledge is also represented in the super-personal knowledge being in a way "dissolved" in the latter, rather than added to it.

One may suggest the existence of some aspects of unity of development of human self-conscience and self-conscience in science. Similarly to ontogenetic recapitulation of phylogenesis, cognitive "ontogenesis" should recapitulate cognitive "phylogenesis". Describing the "nominization" process of an individual, P. Teilhard de Chardin emphasizes the phenomenon of reflexivity as a testimony to the waking up conscience and self-consceince.

"Reflexion is an ability, acquired by conscience, to focus on itself and master itself as an object with its specific stability and its specific meaning; the

ability not only to cognize itself, not only to know, but to know that you know. By this internal individuation, the living element, previously dispersed and disintegrated in an oblique circle of percepts and actions, first come to exist as a centered point, where all notions and experiences are bound and bonded into an integral whole conscious of its organization. A reflecting being, owing to this focus on itself, suddenly becomes capable of development in a new sphere. Abstraction, logics, thoughtful choice and invention, mathematics and arts, aimed at perception of space and time, anxiety and dreams of love... All these internal life activities are nothing but agitation of the newly created center that gets onto fire from within" [14, p. 136].

In this fragment, Teilhard de Chardin describes the essence of intraindividual reflexion and substantiates its role in the development of an individual as a personality. Initially conscience is non-reflexive, one may say, extraverted, directed to others, object-oriented. The same is true of the social conscience. Absence of autobiography as a genre of literature, self-portrait as a direction in fine arts, etc., are indicative of this initial stage. More complex forms and mechanisms of functioning of social conscience lead to emergence of reflexion.

To major extent, the emergence of science as an activity dedicated to production and transmission of new knowledge is bound to the appearance of reflexive criticism as a mode of functioning of knowledge. The social atmosphere, in which reflexive criticism was cultivated, first appeared in the democracies of the antiquity, that fostered competition of ideas, promoted methods of intersubjective argument and persuasion that in the long run lead to the development of logics and rationally organized science.

From the very beginning, the scientific thinking was accompanied with the activity of critical reflexion. This activity has been developing gradually, so one cannot say the emergence of reflexivity of modern scientific cognition is akin to Minerva coming out of Jupiter's head, adult and mature. According to E.G. Yudin [20], three subsequent stages may be discriminated in the development of the intrascientific reflexion. Following P.P. Gaidenko, Yudin calls the first and the second stages "*the ontologism*" and "*the gnoseologism*", respectively. The former one stems from the Aristotle's concept of the truth, goes through the classical science and ends in the middle of the 19th century. The latter brings the reflexivity through the science of the 20th century into the 21st.

The ontologism focused the reflexion on the "knowledge-object" opposition. The object was conceived as "Book of Nature" written by the Divine Reason, and, consequently, the knowledge of the nature is akin to the natural theology focused on reading the Book of Nature, its reconstruction in human mind. However, human thinking is not perfect, it is overwhelmed by various "idols" misleading it to false and erroneous trails... That is why the specific task of the reflexivity was liberation from "the influence of "idols" leading the knowledge

astray", i.e. clarification of "how the "idols" act and what measures should be taken to neutralize their impact" [19, p. 17]. When D. Home and I. Kant questioned human cognition unsupported by the Divine Reason, the focus of attention shifted from the "knowledge-object" opposition to the "subject-object" opposition, and, consequently, the stage of "gnoseologism" substituted for the "ontologism". The gnoseologism formulated the problem of subject's active role in the process of cognition, thus signaling repudiation of the major assumptions of the preceeding form of self-conscience in science. Once the object is no longer the outcome of the Absolute Reason, it appears to be detached from the subject, opposed to the subject's cognitive abilities, comprehensible to a certain very limited extent, if any. Stressing the "opacity" ("invulnerability") of the object, the gnoseologism, however, admitted the "permeability" of the subject, the cognition by senses being almost the only realistic communication between the subject and the object. The logical, rational cognition is not reliable, may be only auxiliary, so far as it is composed of concepts forbidding any direct descent to sensory data. This interpretation of cognition was best expressed in positivism and neo-positivism. The influence of gnoseologism, however, extended beyond these philosophies [19, p. 18].

Methodologism characterizing the third stage in the history of scientific reflexivity, goes back to the New Time science [15, p. 85]. It is characterized with the "subject-knowledge" opposition. This opposition reflects recognition of a complex reciprocally conditioned nature of the state and orientation of the subject by the knowledge available, the socio-cultural environment, the nature of the subject's own activity. The object is considered not only as something involved in subject's activity and directly accessible to subject's reasoning, but rather as something given to the subject "through the prism formed by the intricately arranged whole of heterogeneous knowledges that the subject has at his disposal" [19, p. 18].

Within the framework of "the activities approach", the concept of "subject" includes the content of subject's activity. "The activity of subject's cognition is considered not only as most important form-building factor, but also as incorporated into the content of the subject" [*I.A. Rakitov*, 10, p. 62]. "Reflexion not so much describes the activity as constructs the latter" [12, p. 163].

As a kind of reflexion on a qualitatively new theoretical and experimental situation in scientific and technological cognition, "the activities approach" fits into the essence and the rationality type of non-classic science [5]. The specific features of contemporary non-classic science are manifested not only in the relativistic and quantum mechanics principles that chronologically preceded the development of non-classic concepts in other areas being a kind of reference-points and providing the guidelines for new assumptions focusing on the activity as a core of cognition, but also in creation

of a new style of scientific thinking with the elements of self-control, self-regulation and self-perfection that are implemented in different forms of reflexion.

2. Specific features of reflexion in contemporary science

The goal-directed search for methodological principles may be accounted for by growing complexity of concepts, means and methods of cognitive activity and by the need for synthetic concepts and notions that make possible to build up a generalized image of a scientific area and to "perceive" the tendencies and prospects of the development. This search may lead to methodological principles and ideas of different levels of generalization. It may be shaped as a methodological study of the structure of scientific knowledge and specific theories, of regularities of their functioning and mechanisms of changes, etc., thus approaching specifically philosophical problems. On the other hand, it may develop as a formal methodological study dealing with languages, deductive and expressive means and possibilities of scientific theories, peculiarities of their formation, etc. In the latter case, methodology represents a meta-theoretical study that was historically the first form in which reflexion gained its status of a specific level of intra-scientific research.

The development of meta-theoretical studies, *the meta-theoretical reflexion*, is a regular product of revolution in logics, mathematics and physics. However, a kind of reflexion inadequate to its object may also occur. Illusory constructions, pseudo-explanatory schemes of scientific cognition, ignorance in philosophy as an intrinsic constituent of the cultural context in which specific scientific knowledge develop all these usually signal false reflexion [16, p. 48].

The art and science of reflexion is in the reveling of the underlying prerequisites, mechanisms of progress, laws of movement, logics of development, "norms of life", systematic and integral features of scientific theories, in other words, in penetration into the essence of the object that is mostly beyond the researcher's horizon delimited by the frontiers of knowledge. The goal is approached through questioning different concepts and systems of different levels of cognition. According to V.I. Kuraev and F.V. Lazarev [3, pp. 228-229], "Reflexion in its essence constitutes a specific sphere of subject's cognitive activity in which all epistemological phenomena (abstractions, models, theories, etc.) in their clear an crystallized forms are used as tools of cognition, are in a way "melted" and disintegrated into elements. Formulating problems and questioning constitute the *inner nerve* of the reflexion activity." The interweaving of reflexion into the texture of scientific theoretical thinking is predetermined by the basic need for understanding of the role and status of a certain concept in the continuously growing informational "saturation" of modern science...

An important objective of any procedure of reflexion, i.e. justification of a certain area of knowledge, is also the main objective of meta-theoretical studies. It is noteworthy, however, that the procedures that initially seemed to have only justificatory destination, appeared to provide "a peculiar mode of development of the content of knowledge… These represent both the results of coming beyond the limits of a conceptual system, and the means of such coming beyond" [4, pp. 261, 263].

Methodological study of scientific reflexion is aimed at the mechanisms of the cognitive relation in which a subject gains knowledge of a radically new, related-to-itself type. Owing to this, the subject's thinking becomes non-linear, a kind of a "second derivative thinking". It is the relatedness-to-itself of the knowledge that attaches to the complex system of self-cognition of science a status of both a factor of orderly arrangement, reorganization and analysis of backgrounds of knowledge, and a factor facilitating optimal functioning and self-regulation of all levels of scientific activities (most vividly manifested in basic research). The possibility of relation to itself is provided by the engagement of conceptual structures of high level of abstraction, generalization and expression, by use of powerful argumentation systems. The knowledge gained in meta-theoretical studies provides an example of this kind. On the other hand, elaboration of this kind of knowledge is accompanied with the discussion on the criteria of science that form the values and norms of the self-conscience of science.

Realization of reflexivity includes, at least in a latent, "compressed" form, the major mechanisms of the systems approach and develops along the guidelines of the latter. First, as a result of reflexion, the object is better delimited, that is reflexion is a powerful means of objectivation. Secondly, the process reflects the peculiarities of functioning of the immediate constituents of the object. Thirdly, a specific "multidimentionality" of the object is revieled, i.e. the availability of relatively autonomous strata that may have different epistemological significance. One may point to the ideological congeniality of the systems approach and the methodology of quantum mechanics. However, the major part of this correlation is outside the attention of both students in the methodology of physics and developers of the concepts of the systems approach.

The new scheme of scientific interpretation worked out in the process of realization of reflexive procedures of different levels of generalization and typical both of the systems approach and the methodology of quantum mechanics is connected with conceptualization of a phenomenon, a structure as a non-analysable integral whole and with research aimed at mechanisms determining this whole. This understanding was worked out by N. Bohr in his search for an adequate interpretation of the quantum mechanics formalism, and is further developed within the framework of intra-theoretical reflexion by D. Boeme and his co-workers.

One may suggest that the ideological congeniality of the systems approach and the quantum mechanics methodology is deeply rooted in the background processes that took place during the first half of the 20th century and that have generated a new style of scientific thinking that incorporates criticism and reflexion that are decisively important for the new form of self-conscience of science, the methodologism. Indicative of the above-mentioned ideological congeniality is the following fact.

The institution of a specific reflexion system of science as a form of self-conscience of science chronologically coincides with the emergence of the systems approach in its methodological aspect in the 1930s. According to B.A.Starostin, "Science that has developed the systems methodology could not but recognize itself as a system. The rise of sociology of science in the 1930-ies and institution of the contemporary scientology are realizations of the systems approach... The same is true of any research insofar as it comprises a piece of scientology, be it only in the form of recognition of relation of this particular research with the studies of the predecessors" [13, p. 10]. The history of science includes the reflexion of scientists as an important component because understanding the necessity of methodological rearmament of a given discipline provides powerful impulses to tectonic motions in science.

The rise of sociology of science and the growing number of extended studies in the history of science in the second part of the 20th century signal not only the scientific drive to self-cognition in the spirit of creation of the picture of the system of scientific activity, but also an attempt to penetrate into the non-reflexible, "personal", "implicit" knowledge. Studies in this relatively new bulk of non-reflexible knowledge revieled its functions and nature as a prerequisite of every cognitive process and cast a new light on the mechanisms of transformations of the implicit assumptions into the explicit ones. Consequently, one may speak of the reflexible and the non-reflexible in cognition.

Interaction of the reflexible and non-reflexible elements of cognition occurs practically in any self-analytic procedure (both on the level of human conscience and on the level of self-cognition of science). Actually, reflexion presupposes the availability of a certain meaningful background, means and tools of understanding, corresponding with a certain historically determined inventory of theoretical and practical possibilities of the subject. Outside this background, no understanding, comprehension or interpretation may take place. The background itself may become a subject-matter of study some day, but again its interpretation would require the availability of non-reflexible meaningful background, implicit knowledge. So, the act of reflexion is accompanied with gaining new (explicit) knowledge, as well as new implicit knowledge. This process is bound to the specific levels of reflexivity, both new knowledge and the accompanying implicit knowledge appear to be relative to the level of

argument and type of judgment. Conversion of the non-reflexible knowledge and experience into the reflected knowledge opening the way to self-conversion makes the accepted meaningful constructions instable and lays grounds for the revision of the generally accepted paradigm and elaboration of new methods of development and justification of theories. The ethics of scientific activity is clearly involved into this process.

Reflexion is also a participant in the "link-up" of the theoretical and empirical levels of cognition. Regardless that these level are relatively autonomous and develop "in parallel" according to their specific inner logics, science automatically reproduces mechanisms of correlation of their development. Parallel progress of theory and experimentation, as V.I. Arshinov notes, "is maintained by an additional level of methodological reflexion in the system, the level of correlation and coordination of the objectives of theoretical and experimental cognition by means of assigning a common scientific mission" [1, p. 171].

3. Mechanisms, types and levels of self-cognition in contemporary science.

Contemporary science has built up a multi-level hierarchical system of self-cognition, each "storey" of this system loaded with problems of greater or minor philosophical significance. The complex, multi-level and ramified contemporary scientific knowledge "inevitably presupposes the variability of types and levels of reflexion" [15, p. 27]. Consequently, methodological analysis of science is not homogenous in its nature as it is differentiated into a number of subsections engaged in the studies of the empirical knowledge, concepts in the branches of sciences, interdisciplinary concepts, etc.

The objective of the self-cognition system in he contemporary science is the search for regularities in the development of science, the study of revolutionary changes, of the basement of scientific knowledge. The objective in the sphere of organization of science is the efficient and prompt regulation of functioning of the mechanisms of enrichment and development of the scientific knowledge. An historical overview of the sources of development the system of self-cognition in contemporary science shows that criticism and questioning have had much deeper outcomes than those that might have been expected provided they were aimed merely at restructuring the scientific programs within the framework of the same conceptual content.

Questioning the reliability of the basic pre-requisites appears to be the first push that eventually brings a theory (research program, etc.) to the stage of reflexivity capable of conceptual reorganization of the object and of establishment of a feedback loop between the theory and its basis. Taking into account the type of argument used in the reflexive procedures and, partly, the declared objectives, the reflexivity of the contemporary scientific knowledge may be subdivided into *intra-theoretical*, *meta-theoretical*, *interdisciplinary*, *general scientific*

and philosophical-methodological reflexion. The character of the arguments is often indicative of the level of reflexion.

One may speculate that the intra-theoretical reflexion is a primary, basic form of self-conscience in science that subsequently "rises" (or tends "to rise") to the level of philosophical-methodological reflexion. In any case, the intra-theoretical reflexion is a necessary pre-requisite of the philosophical-methodological reflexion. Each level and type of reflexion has its own objectives and functions with their specific features. This attaches a kind of integrity to the system of self-conscience of science. Of course, the proclaimed stages of development of reflexivity of the scientific knowledge represent a kind of a simplified classification, a sort of an idealistic model of the process. Actually, the process does not follow a strict program (however, tends to follow). Problems causing "polyphony" of the reflexive procedures exist on all levels of scientific knowledge. The arbitrariness of the borders between the levels of reflexion should also be noted.

Within the limits of each level, the reflexivity of knowledge is realized as a procedure of self-reflexion. The levels are complementary, i.e. each higher level incorporates and presupposes a lower level, incompatible with the former in some respect, as an intrinsic element of functioning.

The availability of relatively autonomous levels of reflexivity of the scientific theoretical thinking, its "stratification" into intra-theoretical, meta-theoretical and other kinds of reflexion, their mutual transitivity and interaction characterize the structure of the rationality of science that appears to be in the process of qualitative change. On each level, reflexion arranges and organizes knowledge to reveal its generative mechanisms, to clarify the implicit assumptions laid into the basis of functioning of these mechanisms and, most important, makes possible estimation of a given section of knowledge as a part of the integral system of scientific activity, evaluation of prospects and compatibility with various constituents of the socio-cultural reality.

The complexity of the objects of contemporary science often requires extremely sofisticated technique of cognitive activity. Hence the necessity to keep in the focus of attention both the subject together with the conductors of his activity and the object interacting with these conductors, as this interaction generally impacts the subject (the surplus of knowledge causes rearrangement of activities) as well as the object (the object involved in the activity reacts to it, albeit "passively").

Intra-theoretical reflexion. One may conceive of the intra-theoretical reflexion as of the "lower" level of the system of self-cognition in science. It may also be thought of as of the elementary unit of analysis. This kind of reflexion typically arises in the attempts to arrange, organize or make more precise the knowledge, or simply to estimate the results of studies within the framework of a

specific theory. Arguments used in this case are built up within the theory reflected, not outside its frameworks. The intra-theoretical reflexion usually does not end up in radical revision of the theory or clarification of its basic assumptions (it may, however, foster creation of a more generalized theory or formalism). That is why one may consider it to be only a sort of an "embryo" of true reflexion if the latter is considered as critical procedure realized by trespassing the limits of the theory that opens a possibility for the "outside" view and transformation of the object. However, the importance and wide distribution of programs of this kind in sciences allows one to consider the intra-theoretical reflexion as a simplest and elementary unit of self-cognition in science. An example of such a reflexion is given be the discussion of the problem of completeness of the quantum theory, that was precisely intra-theoretical, if the kind of argument and type of judgments are considered, regardless the fundamental philosophical-methodological, general scientific and meta-theoretical problems that were formulated in the course of the discussion.

Distribution of intra-theoretical reflexion in the scientific community may convert it into an intra-program and/or intra-disciplinary reflexion (with still further conversion into what may be called meta-program or meta-disciplinary reflexion), each kind includes elements of intra-scientific type of justification of knowledge.

As in the course of intra-theoretical reflexion no final strategic goals (philosophical justification, arrangement, re-evaluation and reconstruction of the theory at a qualitatively new level are generally reached, elements of higher levels (meta-theoretical and, more frequently, philosophical-methodological) are present at this level. In the subject of intra-theoretical reflexion such presence sometimes produces an illusion of reaching the ultimate goals, of completeness and integrity of the picture synthesized as an outcome of the procedures of self-analysis. The assumed strength of the intra-theoretical reflexion supports the opinion, according to which philosophy, and any "metaphysics" in general, are overdue, and the intra-theoretical (intra-program, intra-disciplinary, etc.) means of analysis of scientific assumptions are self-sufficient.

Insufficiency of a partial consideration of complex problems that require the analysis of the basic concepts of knowledge, limitation of the analysis procedure to the context of the theory that has generated these problems usually appeals to considering the object of reflexion within a conceptual framework wider than a single theory, within a space of concepts and ideas of more universal and general character.

Meta-theoretical reflexion. The Hoedel theorems revealing impossibility of realization of Gilbert's idea of justification of mathematics by "internal", finite means, and other results of meta-theoretical studies were first to convincingly

demonstrate the insufficiency of the intra-theoretical analysis of problems related to the basic concepts of formalized theories.

Problems of status of mathematical postulates, of theoretical non-contradiction, of completeness of a theory, of independence of axioms, that emerged in the course of development of mathematics (geometry), could be resolved only by "external" means. This challenge was met with emergence of a qualitatively new (for logics, mathematics and other "special" sciences) type of cognitive and research activity that was reflexion-oriented, aimed at studies of the basic concepts of knowledge, of their reliability, of methodological pre-requisites and properties of theories as holistic system constructions. The "grains of truth" of the Gilbert program and Hoedel's discoveries related to criticism of cognitive procedures in logic and mathematical sciences and to emergence of specific self-control mechanisms were laid into the basis of studies that exercise meta-theoretical functions. Contemporary meta-theoretical studies go far beyond the logics of mathematics into physics, cybernetics, systems theory, etc. One may consider this as a formation of a specific meta-theoretical level of reflexivity of scientific knowledge. Meta-theoretical studies are probably the first form (apart from philosophy) in which reflexion has gained the status of an autonomous level of research. One may suggest that this was a result of the process of making explicit the cognitive function that was not concerned with the studies "of its own storey, but with looking for a lift to the next one" that was realized in the procedures of introduction of "meta-variables" that amalgamate numerous old objects into new ones that belong to a new level" [7, p. 102].

General scientific reflexion. Complex and super-complex objects of contemporary science, growing number of complex systems studies, the overwhelming use of mathematics in presenting the scientific knowledge promote emergence of new directions of studies and research programs that provide general ideas, concepts and approaches common for different disciplines, e.g. cybernetics, informatics, various interdisciplinary projects. Whereas the inter-disciplinary research projects have been an acknowledged form of interaction between scientists for sometime already, the process of construction of the general scientific knowledge on the basis of the generalized concepts of cybernetics, information theory, systems theory, synergetics, etc., and cooperation between all branches of sciences is only in the beginning of its way toward implementation of a most challenging mission of contemporary science, the synthesis of the scientific knowledge. The contours of this knowledge however, may be sketched today.

The nature of the phenomenon of universal significance in science is determined by two factors. First, it meets the internal needs of development of natural sciences and mathematics and in this respect may be considered a new direction of research accumulating the tendencies toward a synthesis of scien-

tific knowledge. Secondly, it has a powerful potentiality of re-evaluation of many traditional scientific concepts thus signaling a new level of reflexivity of scientific research that in a way incorporates the proceeding meta-theoretical level and opens realistic prospects for integration of sciences.

So far as the integrative tendencies in the contemporary science are connected with the mechanisms of self-reflexion and self-analysis of theoretical cognition, the general scientific level of reflexivity functions as a catalyst of inter-theoretical exchanges. The organizing function of the emerging general scientific reflexion, however, is not limited to stimulation of inter-theoretical exchanges (no matter how important a factor this may be), but also extends to elaboration of a set of ideas providing common grounds for search in different and seemingly distant phenomena, for creation of conceptual frameworks of universal epistemological and methodological value that make possible coherent representation of knowledge. In addition, the search for cohesion of scientific knowledge is aimed at providing patterns of more compact, "zipped" representation of factual information.

Philosophical-methodological reflexion. Whereas the general scientific knowledge as a form of emerging reflexion in mathematics and natural sciences is in a way non-traditional, philosophy since long ago and traditionally has maintained the priority of general scientific (and general cultural) reflexion. Philosophical problems and concepts are generated on all levels of methodological studies, in every branch of science that reaches a certain threshold of complexity. From the philosophical-methodological level, a kind of "X-raying" of conceptual content of all other levels is exercised and evaluation of contribution of science into culture in normative and social aspects is made.

The contemporary scientific cognition requires not only "reshaping" of one form of reflexion into another one that extends to a larger area, but also enrichment of a specific type of reflexion. The intra-theoretical type of reflexivity, practically, coincides with the internal theorizing. However, on the meta-theoretical stage a kind of "re-duplication" of knowledge occurs, the knowledge splits into object-related and meta-theoretical. At the level of philosophical-methodological reflexion cognition "initializes" the mechanisms of self-conversion and analysis of its own basic concepts in a different and/or wider context than the one required by the activity, thus "alienating" itself to the extent making possible self-reflexion in order to estimate cohesion of the subject and the object, the limits of their co-incidence, the measure of objectivity of the truth. Philosophy may serve both as a general scientific means of cognition and as an instrument of meta-theoretical studies. This peculiarity of the upper levels of reflexion opens prospects for in-depth studies, for a critical reconstruction and reconsideration of an object, as well as for a new kind of knowledge.

Each particular case of philosophical-methodological reflexion emerges as a response to a signal from a certain particular fragment of the scientific knowledge and is directed to a specific "crucial points" of the latter, that may differ in their nature and the degree of generalization and fundamentality, the analysis of which may modify the status of the given theoretical system. Reflexion occurs where understanding is deficient (in this sense, reflexion and understanding are complementary [16, p. 170]). This may be illustrated to a certain extent with the situation familiar to all that call for a physician.

Feeling sick, a patient describes symptoms of his disorder. He may be aware of the particular illness and even of the methods of treatment and the required drugs. However, a physician would draw his own picture of the illness, would diagnose it by means of matching the symptoms. The patient may suffer from the so-called "phantom pains" caused by emotional stress rather than from realistic functional or physiological disorders. A good physician is also a little of a psychoanalyst. Being capable of empathy, he estimates the symptoms against the background of the patient's emotional state by establishing therapeutic relation with him and, at the same time, preserving his external (reflexive) position with its specific norms, ways of judgment, estimation and forecast.

Philosophy may be compared to such a physician and theory (research program, concept, etc.) to the patient. The latter "experiences" its own difficulties and uses intra-theoretical reflexion to overcome them, whereas philosophy, attentively and respectfully, constructs its own panorama of the difficulties in a different conceptual space, according to different norms, with different means and at a different level of abstraction and generalization. Owing to this detached position, philosophy finds itself beyond the reflexive picture drawn by sciences themselves, clears this picture from unimportant details and insignificant "actors" to the extent that makes possible clarification of the logics of emergence and development of a concept or theory and the sequence of changes of structural-conceptual formations.

The role of philosophical-theoretical reflexion in science may be compared to the teacher of self-cognition and self-conscience that is capable to draw a picture of a realistic strategy of cognition to substitute for unrealistic dreams.

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PSYCHOLOGICAL STUDIES

ROLE OF REFLEXION IN CONSTRUING A SUBJECT ACTION

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> *Live reflexion is a genuine self-penetration*
> *of spirit.*
> Novalis

The division of psychic functions into lower and higher ones has long since existed in psychology. The first ones are called natural, direct, elementary; the second ones - cultural, indirect, of a complex composition. Willful action, willful attention and memory, sign-symbolic and verbal forms of thinking, creative imagination, lyrical and aesthetic feelings etc are referred to the upper functions. If one continues this classification, then reflexion should be referred to a category of "superhigher" psychic functions, as with its help the bases of any actions are clarified, irrespectively of whether they occur in reality or in thought. Iosif Brodski called reflexion a postscript to a thought, but it also acts as, so to say, a prescript in relation to a wide class of most diverse actions: from executive up to intellectual ones.

A question arises whether so highly lifted reflexion has its own bases of its existence and development? And, if it does, whether it is possible to find them within the structure of psychic acts habitually called elementary? Detection of prototypes of "superhigher" reflexive acts within elementary actions will allow also to doubt the usual dichotomy of higher and lower psychic functions. It is to clarify these questions that this rendition is devoted to. As action is opposed to reaction, so reflexion is the opposition to reflex. In Russian language its is quite evident:

<div align="center">

Reflex   Reflexion
(the latter word "refleksiya" in Russian sounds the same as "refleks i ya",
which literally means "reflex and me")

</div>

though without the elementary forms of reflexion even a conditional reflex

cannot be formed. The phenomena of reflexion, as well as the phenomena of initial attitudes, for example, the initial aspirations toward light, represent a necessary initial condition for existence and development of living entities. These phenomena are prebehavioral, prepsychic, preconscious.

Without going deep into the phylogenesis of animal foreforms of reflexive acts let us turn to observations over infants. Brunner and Kozlovskaya carried out a research purely fascinating in terms of planning, execution and results, in which they have showed that two-month infants are capable to estimate the size and remoteness of objects demonstrated to them[1]. Naturally, a word or snatching of an object could not be the evaluating indicator, , as at this gentle age those are ruled out. The intention to snatch, when a child with all its body reached toward the object, served as the indicator. Such intention was observed under two conditions only: when the object was commensurable with size of the child's small palm and potentially was within the reaching zone of the child's tiny hand. Intention to snatch distant small and large close object was not observed. It is only self-confident adults who try to get the Moon from the sky with their hand. As different from them, infants are naive realists. They commeasure their capabilities with the situation, with the conditions to gain the object. This is precisely the essence of a reflexive act, irrespective of whether it is sensual, affective or intellectual, rational or intuitive, conscious or unconscious, psychic or prepsychic. According to Vinnicot's bold assumption, a two week old infant already has a picture of the world and of himself/herself within it. Moreover, Vinnicot attributes to an infant a magic feeling that it is he/she who has created this world.

The intention of the researchers themselves was to prove that infants possess apriori abilities to perceive space and spatial relations, and they did that excellently. Probably, besides their will, they showed also another, more important thing - children's ability to compare the perceived relations with the possibilities of an action impossible here and now, but only potentially in the future. The authors achieved a kind of a pure reflexive act accomplished without a preliminary experience. An indispensable condition of the latter is the availability of feedback that was absent in the infants' behavior. The researchers of childhood found that children of much older age had an ability to plan and to simulate their actions before the action. When the action takes shape, the space of reflexive evaluation will extend due to the inclusion into it of the time coordinate. For example, a Russian crossing a street on red light (the residents of other countries cross it only on green light), estimates his/her abilities to overcome the distance within the necessary time and, fortunately, in most cases estimates them correctly. The acts of reflexion have also another, a substantially larger time measurement. Thus, "the desert of non-action tragedy" (Vygotski's expression) about the Prince of Denmark completely, except

for the last stage, is filled with reflexion by Hamlet, who quite consciously looks for his sole act [2].

In all cases quoted, as well as in the situations of reflexive management typical to mutual relation and interaction of people studies by Lefebvre and his followers, a comparison of two evaluations is central [3]: evaluations of the situation and evaluations of one's own state and ability to act in the situation. It is, so to say, the nucleus of the reflexive act. Lefebvre introduced the concept of a rank of reflexion and used a metaphor of two matryoshka-dolls for the description of humans' reflexive interaction. The same metaphor can be used also for the description of levels of reflexion characteristic to the individual behavior of a human beyond the situation of interaction with another human, or, using lofty words, in a situation of game with nature or with himself.

For the description of reflexive acts the primary attention was given to higher levels and reflexion was seen as a function or a derivative of consciousness, activity and/or personality. Certainly, such acts do not always require as long time, as Hamlet's hesitations. There are acts that have a complex biomechanical and kinetic configuration and are done promptly, on a quasi-impulse, without visible loops of feedback. However, intuitively it is clear, that an act in the real sense of this word represents a personalized act having a value-based dimension; it is not unconscious, but superconscious; at times, it is the result of the whole previous life of a human. Consequently, it is reflexive, though it would seem that its prompt execution excludes hesitations, excludes a conscious evaluation of the situation, one's abilities to act in it and their comparison. But, nevertheless, the act is done, it occurred. One can, of course, explain the mechanism of doing an act by means of an analogy to the *unclear* mechanisms of instinct, intuition, revelation and/or insight and call it the result of a behavioral situation, even of "an intuition of conscience" (Ukhtomski). However, a change of the name will not make the mechanism of an act clearer. There are no doubts only about the fact, that to commit an act it is necessary to muster one's spirit. And within spirit, according to Hegel both mindful reason and reasoning mind are present, i.e., the very same reflexion.

Let's accept as a hypothesis, that an act represents a consequence, an external form, a higher level of execution of mysterious conscious and reflexive acts that constitute its internal form. If this assumption is correct, then the foreforms (and mechanisms) of such acts can be found out also in less heroic types of behavior and activity, in quite prosaic voluntary and involuntary actions and even movements. Let's look for, so to say, some background (zero in comparison the act), initial levels of reflexion in live movement and its biodynamic fabric (Bernstein's terms).

By what a live movement differs from a lifeless one? It is the same riddle, as well as the one asking by what a live substance differs from a lifeless one.

Newton's question of how the movements follow the will (we shall add: the intelligence as well) remains so far without an answer, though nobody doubts the existence of voluntary, clever and free movements and actions. We suspect that the answers to such questions cannot be received for as long as the will, the intelligence and the affect, in relation to the movement and action, are seen as forces external and alien to them. Wise Hegel understood that. Discussing a question, how a man becomes a master of his body, he pointed out at a special reflexion, thanks to which the movements of the body commeasure with diverse circumstances of the outside world. Due to that special reflexion they become free. Hegel linked also a free spirit to the movements: "... Spirit itself is not something abstract and simple, but a system of movements, within which it distinguishes itself at moments, but within this very distinction it remains free" [4]. That can be seen as the philosopher's challenge to the future psychology.

Let's proceed from the assumption that a live movement represents an individual's functional organ (Ukhtomski) [5], to which evolution, involution and reaction are inherent (Bernstein) [6]. Zaporozhets and Lisina added to these properties of movement one more – perceptibility as a major condition of mastering one's own movement, a condition of its comprehension and voluntary nature [7]. For the beginning of the answer to Newton's question that is not so little. Let's try to elaborate the logic of the above-mentioned scholars by turning to the results of the study of elementary executive actions.

The elementary structure of any executive action including its latent stage that prepares the answer, actually the execution as such and the stage of correction and evaluation of the result has been known for a long time. The first and the last are called cognitive stages, while the second is called the motor stage. For as long it has been known that the first and the last stages are heterogeneous formations. The latent stage includes: perception of a signal, making a decision concerning the expediency of action, planning of the motor answer and, at last, transfer of the appropriate signal to the motor body. The stage of evaluation only for the sake of convenience can be called cognitive, as it consists of alternating evaluation and corrective movements and only ends with a "clean" evaluation of the result.

As different from these stages that are sufficiently complex in their structure, the motor stage for a long time has been thought to be extremely simple, subordinated and blindly carrying out the commands taking shape at the latent stage. It was as if the motor stage was denied not only reasonability, but also the presence in its biodynamic fabric of any psychological content at all. It was seen as exclusively external execution (response) and other outside commands. Such primitive enough view of psychologists, which by the way caused the opposition between the external and the internal, was shook by studies of

Bernstein, who proposed the principle of ring control of movements. In a ring, instead of a reflective arch, it is difficult, in general, to distinguish between cognitive and motor components of movement. Within it, even the least strict separation of external from internal is impossible. Today there is a huge number of modifications of Bernstein's initial model, and in those even the least clean form of distinguishing the motor components of movement from action is difficult to accomplish.

Despite the riches of the empirical data received by the followers of Bernstein, their psychological interpretation is obviously insufficient. "Driving forces" of live movement, such as reason, will, feeling, effect (backup) and feedback, are still considered (when are they recalled?) as forces external in relation to movement, instead of inherent to it, as non-present in its biomechanical fabric. Carrying out our own research, we presumed that the driving forces, the mechanisms of construction and control of live movement must be found in itself, in *the internal form* of its biodynamic fabric, in its internal picture, as Zaporozhets used to say.

Detailed study of *sensitivity* of the action's motor stage as such was the starting point and the purpose of our study. It is well known that any form of sensitivity represents a virtual reality for a researcher, for it cannot be observed directly. That is, certainly, except for a situation of self-observation, the completeness and reliability of which, as it is known, is rather doubtful. Its measurement is done not directly, but by various indirect attributes. For definition of *the sensitivity of movement* we used meanings of psychological refracterability that describe a possibility of prompt reorganization of the current action and organization of a new action. A simple horizontal sensor-motor action done by experienced and well trained tested persons was studied, on the average within 750-800 ms, the latent stage of which equaled to 220-240 msec, the motor stage – to 380-440 msec and the control and correction stage – to 130-180 msec [8].

The methodical approach consisted of introduction of an emergency target suddenly shown to the tested persons on the same horizontal axis, as the main target, but on the side opposite to it. The emergency target was shown in 30% of the tests in a random order among the background ones at different moments of the movement toward the main target with the gaps of 20 msec and the obligatory priority to deal with it. The tested person carried out the tracking by means of a graphic tablet pen. Analysis was taken of all single records of the acceleration curve in the process of the movement toward the main target, with four characteristic phases consecutively marked on the curve, their duration and the addressed localization of the emergency target determined (Fig.1).

In the figure, the main action with its integral stages and phases is represented by the acceleration curve A(1). The borders of the four phases of the

acceleration curve in the process of the movement toward the main target: 1 and 2 – phases of acceleration [A(t)>0]; 3 and 4 – phases of deceleration [A(t)<0]. K – the refracterablity curve.
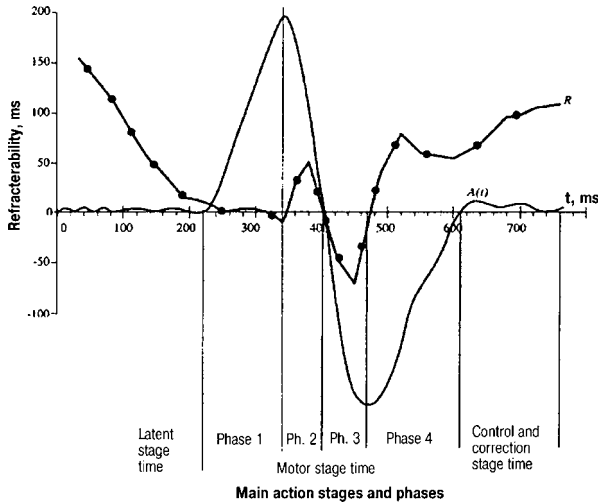
Fig.1. Dynamics of the refacterability in stages and phases of wholesome action

In each case the meanings of the psychological refracterability were calculated. The size of the refracterability is equal to the difference between the time of reaction to the emergency target and the main target (the time of reaction as concerns the main target and the emergency one was measured by the time interval from the moment of showing of each of them till the start of movement toward accordingly to main target and the emergency one). The high meanings of refracterability testify that the organization of emergency action goes with more difficulty in comparison to the organization of the main action and that the sensitivity to disturbing influences is minimal. On the contrary, the low meanings of refracterability testify to a high promptness of the organization of the emergency action and, hence, to a high sensitivity to the subject situation and the disturbing influences.

The behavior of the refracterability curve as related to the action as a whole and its motor stage has quite natural and predictable dynamics. Let's monitor it from the moment of showing the main target. After the showing of the main target, a series of cognitive processes, from the perception of the information to the formation of the program of the forthcoming action, takes place. At this time the sensitivity is maximal as regards to the processes preparing the motor response, and it is minimal as regards to the subject situation. This fact is testified to by the high meanings of the refracterability at the presentation of the

emergency target within this time interval. But when the planning of the main action is completed (approximately 60-80 msec prior to the start of the movement), the sensitivity to its organization falls. Now it is necessary already to turn to the subject situation in order to understand whether there it has remained stable or changed. At the moment of localization of the emergency target at the end of the latent stage, a downturn of the meanings refracterability is observed, which testifies to an increase of in the sensitivity to the subject situation (see Fig.1).

A high sensitivity to the subject situation remains also at the start of the actual motor stage of the action, this fact being testified to by the low meanings of refracterability, if the emergency target is shown during *the first phase* of the motor stage during the movement to the main target. In spite of the fact that the emergency target is shown during the carrying out of the main action, the formation of a new action requires the same or even less time than it is required for the organization of the main one. This fact testifies that when the emergency signal gets into the first phase of the motor stage of the main action, the sensitivity is maximal to the disturbing influences and minimal toward the carrying out of the one's own action, in this case - the action as regards the main target. In the beginning the action is carried out according to the program worked out at the latent stage, and the first phase of acceleration is represented by an impulse specifying the speed characteristic of the whole subsequent action. The data of experiments with switching-off the visual feedback from the controlled cursor within the first 100-130 msec from the start of the movement may serve as an indirect confirmation that this phase has the minimal sensitivity to its own execution. (In our experiment the duration of the first phase falls exactly within this time interval.) The results of the experiment with interruption of the visual feedback testify that the switching-off the cursor reflecting the movement of the control organ within these time intervals not only had no effect on the quality of tracking, but also was not even noticed by the persons tested [9]. Thus, the first phase of the motor stage of the action is characterized by the minimal sensitivity to the execution of one's own movement and the maximal sensitivity to the subject situation.

At *the second phase* of the motor stage of the main action, the meanings of the refracterability grew tens-fold, which is caused by a substantial excess of the time required to organize the emergency action in comparison to the main one (see Fig.1). Hence, within this interval the sensitivity to the carrying out the current movement raises and the sensitivity to the disturbing influences declines. In other words, we managed to find out a change of the forms of sensitivity: the maximal sensitivity to the situation observed at the first phase of the motor stage was replaced with the maximal sensitivity to the carrying out one's own movement at the second phase.

Let's try to understand what causes the increase in the sensitivity to one's own performance here. It was shown above that the maximal sensitivity to one's own performance is characteristic of both the latent stage of the action, when active cognitive processes go on directed to form the program of the forthcoming action, and the control and correction stage, which completes the action and during which there is an active corrective process directed to achieve a precise overlapping of the cursor with the target. It is also known that during the active current control the sensitivity to the carrying out one's own movement invariably grows.

It is possible to assume that the increase in the sensitivity to one's own performance in the second phase of the motor stage is potentially connected exactly to these processes, that is, to the activation of the current control and, with a possible correction of the program, of the current action. However, there is a question here: what kind of a correction can be here, when the analyzed action is a monomovement, within the homogeneous structure of which it is impossible to distinguish discrete components, the presence of which could testify to a possibility of carrying out the current corrections (see Fig.1)?

Nevertheless, such a hypothesis has the right to exist and it can be proven by the fact that the homogeneous structure of the second phase of the motor stage characteristic of the fast main action of the kind analyzed in this work in case of changes of the conditions, for example, those related to a decrease in the speed of the movement, turns to a thin unwrapped structure consisting of discrete quants, the size of which is comparable to the size of the ballistic and corrective movements. In case of stabilization of the conditions, the thin unwrapped structure of the action gradually begins to be wrapped, becoming homogeneous [10]. However, it is only a seemly and purely superficial homogeneity, for as soon as a change of the conditions occurs again, the single action stretches as a spring, turning into a series of micromovements, each with its own program, implementation and assessment.

Hence, within the structure of the action, there is a possibility of unwrapping potentially incorporated, and that means that even a seemingly homogeneous kind of a structure contains both cognitive and executive components, that is, it possesses a sensitivity. Moreover, the fact that a monomovement with a homogeneous structure possesses not just a sensitivity (that fact generally being natural), but also a possibility to change the forms of sensitivity, testifies that this homogeneity only seems to exist. It is possible to assume that the growth of resolution capacity of the means of registration will allow to find out the thin structure of the monomovement.

Let's return to the analysis of the second phase of the motor stage of the main action. From our point of view, the function of this phase is not exhausted with only the estimation and correction of the current action. The possibil-

ity incorporated in it of a necessary correction of the general program of action is of no less importance. When after the reception of the task at the latent stage, a program of the forthcoming action is being formed, it reflects in a general view the speed and spatial coordinates of the future action. *The task-setting pulse* located at the first phase is directed to a greater degree at the realization of precisely the speed component. Certainly, in this case the action is being done in the set direction.

If one were to imagine the action as a wholesome chronotop, then the first phase is rather *a chronos*, than *a topos*, as the function of this phase is to implement the speed set at the latent stage, which is necessary for carrying out the set action. At the second phase the "pure" *chronos* begins to be filled with the spatial topological characteristics. It looks quite plausible and natural, if one recalls the possibility of unwrapping at this phase of correctional movements aimed to correct the mistakes made during the first phase due, for example, to the non-precisely chosen speed of carrying out the action, which, in its turn, might cause miscalculations in overcoming the space as well. Besides, during the second phase a completion of the general program and its concrete definition take place, aimed to change the leading vector, which turns from the priority *chronos* for the first and second phases to the priority *topos* for the third and fourth phases.

In other words, while at the first phase of the motor stage, *the pulse is realized that sets the action's speed characteristics* planned at its latent stage, at the third phase, *the pulse is realized that sets its spatial characteristics* planned at the latent stage and corrected at the second phase is realized. It is possible to assume that there are more similarities than differences in the functions of the first phase and the third one; they consist of realization accordingly of speed and spatial characteristics of the action. But these characteristics themselves were planned earlier, at the stages and phases previous to them, external as regards them. Therefore the functions of the first and third phases can be characterized as mainly "transit" ones, while the correction, estimation and control are carried out at the "productive" phases following them. The description above explains why the sensitivity at these phases is minimal toward the carrying out one's own movement. And indeed, the maximal sensitivity to the implementation, registered at the second phase, is replaced at the third phase with the maximal sensitivity to the subject situation and to the disturbing influences, which fact is testified to by very low meanings of refracterability, during the localization of the emergency target at the third phase of the current action (see Fig.1). The maximal sensitivity to the situation provides for a prompt organization of the emergency action. Thus, the change of the forms of sensitivity was once again registered in the motor component of the action.

Finally, during the transition to the last – *fourth* – phase of the motor stage, the change of the form of sensitivity is again observed: the maximal sensitivity to the situation was replaced with the maximal sensitivity to one's own performance, as it is precisely here the activation takes place of the ongoing corrections aimed to eliminate the mistakes made at the previous phases. And if the emergency target appears during this interval, more time is required for the organization of the new action, as testified by the high meanings of the refracterability. We've said above that if the action is imagined as chronotop, then its first phase can be characterized as *the setting chronos*, while the fourth phase can be characterized as *the completing topos.*

A high sensitivity to one's own performance is preserved also during the whole duration of the control and correction stage that completes the action, as active correcting processes are carried out here, which are aimed to achieve the overlapping of the cursor with the main target. Therefore, if the emergency target is presented at these moments, more time is required to organize the new action.

In conclusion of the brief summary of the research, it can be said that during the short interval of time (the duration of the motor stage makes less than 0.5 sec) the form of sensitivity changes three times and each change has an effect on the efficiency of organization of a new - emergency - action. It is noteworthy that the changes of the forms of sensitivity are precisely dated to the phases of positive and negative acceleration on the relevant curve. The presence of the phase localization of the forms of sensitivity convinces that the transition processes do not take place by chance. They are fully pattern-regulated. What are their psychological meaning and sense?

It is well known that a live movement is discrete. "Kinetic melody" is a perfect illusion of our visual system. The discrete nature of movement is the first condition of its own internal controllability (an avalanche is continuous and uncontrollable). The nature and size of intervals in a live movement is determined by two forms of sensitivity that have been found as a result of the research and ensure the knowledge of the situation and its dynamics and the knowledge of the action itself and its dynamics. Given that, both kinds of knowledge should not be independent, but rather they should be precisely synchronized in time, should be synergetic. It is important to emphasize that the reference here is precisely to the two consecutively alternating forms of sensitivity. Their undoubtedly unconscious change carried out in the process of the action is what was named above the initial, operational, background level of reflexion. Without this level no expedient movement and action is possible. If we return to the question of the difference between the live movement and the mechanical one, this difference consists, first of all, in the existence of two forms of sensitivity changing each other within the time microintervals. That

is precisely the background level of reflexion. It is important that this level ensures control that does not provide for the presence of feedback in a common sense of this word.

The research of more complex kinds of action and activity shows that the background level of reflexion has a rich potential for development. Most evidently this can be shown for means of introduction to the experiment of conditions disrupting the habitual way of carrying out a well-mastered action. Let's consider a situation of introduction of electronic inversion in the well-mastered action of tracking a target [11]. The inversion causes a breakup in the natural balance between the perceptive and motor fields: if a controlling body moves in any direction, the controlled signal always goes in the opposite direction. The adaptation is especially difficult, when three spatial coordinates are inverted. At the beginning of mastering a new situation, the motor stage of the wholesome action disintegrates into a multitude of fast, high-amplitude movements differently oriented and penetrating the operative space in all directions and alternated by long stops, during which the tested person controls the previous movement and prepares (plans) the following one. Such movements are observed on each coordinate of the spatial action. The achievement of the target becomes so chaotic and disorderly that it can hardly be called an expedient action. It rather looks like an aimless roaming. In fact, those are artificially linked chains of separate actions, each having its own direction, speed and point of application (Fig.2). Such description of a chaotic set of
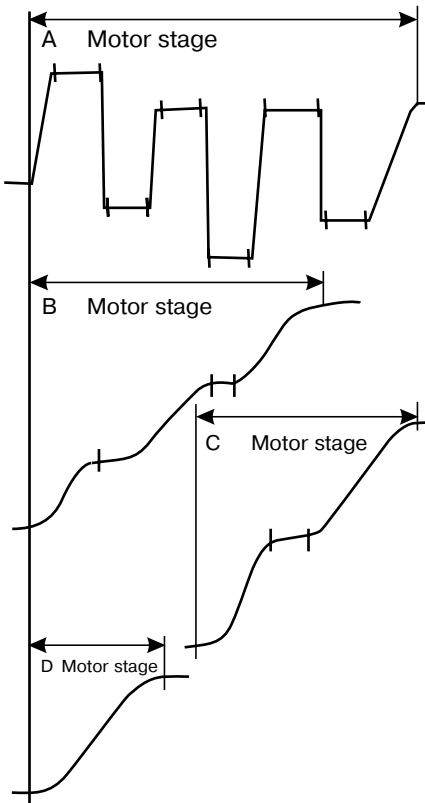
Fig. 2. The chain of changes of the structure of the motor stage during the formation of a new action

A-C – stages of formation of a new action; D – formed action
In the motor stage the stops are indicated – the areas of speed decrease down to 0 (horizontal lines).

movements can be illustrated by Wiener's reasoning about addition of probabilities, all of which are equal to zero: "If I shoot at a target with a point-size bullet, then the probability of me hitting a definite point of the target is equal to zero, though a possibility is not ruled out that I'll hit it; and indeed, in each separate case I'll hit a certain point, which is a zero-probability event. Thus, the 1-probability event, that is, hitting some point, can consist of an aggregate of events, each of which having the 0-probability" [12].

In our case each separate action does not reach the target, but with their help the tested person probes the working space. The executive function of actions is transformed into the cognitive, orientation, research one. Eventually, thanks to these actions, the tested person, albeit laboriously, constructs a new, initially rather imperfect image of the inverted space. As Tolman wrote, the pragmatic vector of behavior is transformed into the cognitive one. During such construction one's own actions become a subject of comprehension. Uznadze would have said that it becomes a subject of objectivation. The actions described in the inverted field remind of the first grabbing movements of an infant, they are as chaotic and purposeless, "these attempts look like very wide-flowing, irradiated and chaotic synkinetics, like something similar to turbulent bursts of wallowing", as Bernstein described them. Moreover, not only a hand, but also all four extremities together with the facial, neck and body muscles participate in an attempt to seize the subject. "Such attack of irradiated excitation may result in a palm casually touching the desirable subject and successfully seizing it, and then everything will end with that. If such successful outcome does not follow, the burst is exhausted by itself to be replaced with a similar attack in 10-20 seconds" [13]. It is noteworthy that in the beginning of mastering of the inverted action by adults, the stops between separate differently-directed chaotic actions also last for 10 seconds or longer.

But these is not just empty intervals and pauses. Each stop is a backlash of the continuing experience, its accumulation and its embodiment during the next attempt [14]. In the process of adaptation and mastering of a new action, the function of long stops is very productive. Moreover, the role of these pauses during the action just taking form, is difficult to overestimate. The matter is that the cognitive processes of estimation, control and subsequent planning that occur during the stops are, essentially, also "the driving force" of constructing a new action. Actually, within the structure of the motor component of the action taking form there is no and cannot be cognitive formations, as the movements at this stage are fast, ballistic, reminiscent of reflective acts. While the cognitive component is brought from outside, as if dividing the two actions, it is on this dividing pause that the main burden of formation of a new action falls. In Ukhtomski's terms, it is an active or operational rest, a time devoted to thinking and estimation. At this time the tested person turns for help to his

internal and sometimes loud vocal speech, that register the results of his/her erroneous and correct actions. Essentially, the tested person experiments with perceptive and motor fields, compares changes caused in the situation by his/her actions with the process features of the latter and then chooses the direction of the next movement. Here one can see a conscious reflexive control in its more customary time-stretched forms.

Both forms of sensitivity also make their contribution to this level of conscious reflexive acts, but they have a considerably larger time constant and usually are described in terms of attention and perception. Their result is the formation of a new action with all stages inherent in this process, starting with the construction of the image of the situation and ending with the construction of the image of the action. Both images are dynamic, and the perception of the situation and the comprehension of one's own actions are discrete. The attention passes from the estimation of the situation to the execution and backward. The discrete nature of perception of the situation allows to detect and distinguish changes occurring in it, including also those of them that are brought into it by one's own action, which, in its turn, is subordinated to the purpose of the movement task: what was, what is, what will be, what should be (almost as in card fortune-telling). Without such knowledge no reasonable behavior is possible. One can assume the existence of some mechanism of checking, of comparison of these types of knowledge, i.e. a mechanism of reflexion, as changes in the situations caused by the individual's own action are the subject of estimation and comparison here.

A comprehension, an objectivation of one's own actions are subordinated to the same logic. They also are discrete. They provide for the distinguishing knowledge related to the requirements of the situation and the purpose of the movement task. Such operational knowledge is quite suitable for "reflexive conclusions" of the type: I can – I cannot, I shall have time – I shall have no time, it is necessary – it is not necessary etc. Thus, in the more complex forms of movement behavior the two forms of sensitivity are corresponded by the two forms of reflexive estimation developed on their basis. The first one can be called sense-related, subject-substantial, the second one - operational, motivation-energetic. In their turn, the following levels of reflexive estimation are erected above them. It is natural, that comprehended reflexion has as its basis the background level described above. After appropriate training the comprehended level of reflexive control becomes excessive, while the background one continues to work. It cannot be eliminated, because its elimination is tantamount to destruction of the expedient action.

How one can present the obtained results about the change of the forms of sensitivity, about their phase localization in the live movement? Is it possible to make it visually perceptible, that is, to find its image? Let's try to use the

image of Moebius' surface for this purpose. Let's imagine that the sensitivity to the situation is the property of the external surface of Moebius' tape and the sensitivity to one's own performance is the property of its inner side. But Moebius' tape is a braided, overturned surface, where in the process of progress along it, the external turns out to be the internal and the internal - the external. Moebius' tape evidently demonstrates the transitions of one form of sensitivity into the other. This image facilitates understanding of the live movement as a multiple heterogeneous formation, as an individual's functional organ should be. Having such properties, the live movement, indeed, can play the role of the initial cell of development of mentality, including reflexion, the role of the undeveloped beginning of the future developed whole. The development of mentality is a consequence of differentiation of such undeveloped beginning, birth on its basis (from it) of new functional organs – new formations. Here we should recall with gratitude Rubinstein's old idea: "To understand the diverse psychic phenomena in their essential internal interrelations, it is necessary, first of all, to find that 'cell', that 'section', in which it is possible to find the rudiments of all elements of psychology in their unity" [15]. Rubinstein suggested to consider action as such 'cell'. It seems to us that the above-mentioned research has justified his forecast.

The background level of reflexion found in the research or its perform plays a very important role in the further development of behavior, activity and consciousness. Hardly anyone can doubt the validity of the tautology: "I act, therefore I exist". In his "Conversation about Dante" Mandelshtam calls Dante a Descartes of metaphor. Dante could have said: "I compare, therefore I live". Mandelshtam explains and strengthens this statement: there is no existence outside of comparison, for existence itself is comparison [16]. It is comparison that makes the nucleus of the background level of reflexion we found. In the process of development both tautologies are transformed into another, better known: "I think, therefore I am". The last one could not emerge without the experience of the first one; this fact once more confirming the active nature of thought.

The origin of higher psychic functions poses, certainly, a special problem, about which rather contradictory views have been expressed. For example, Vygotski considered them the source of consciousness, while Leontyev thought activity was. The idea of internalization is long since known. The point of view is widespread that allegedly the external subject activity deprived of the modus of the psychic generates the internal psychic functions (?). The idea of differentiation, which we developed, helps us, to a large degree, to solve these contradictions. The live movement, of course, has its external form, but it has also its internal, directly non-observable form, i.e., it initially has the modus of the psychic, therefore it would seem that a purely executive action can be trans-

formed into a perceptive, mnemonic, intellectual, affective, communicative one. However, initially it occurs not according to the rule of internalization, but to the law of differentiation. It's another matter that, once developed, the cognitive functions autonomize themselves from the movement and the action and, nevertheless, continue to render substantial influence on them. In this sense Vygotski is right, asserting that the higher psychic functions are generated by consciousness, but it is a separate theme requiring special arguments. Concerning reflexion, it must be an indispensable attribute of any action claiming to be expedient and reasonable. Simple actions are corresponded by more elementary forms of reflexion, complex ones - by higher ones. A human makes mistakes less frequently, while carrying out simple actions supported by the background level of reflexion. However, in more complex situations he/she tends to become confused in the self-plaited nets and in the woven webs of meanings.

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MATHEMATICAL MODELING OF REFLEXIVE PROCESSES

FROM PREDICTION TO REFLEXIVE CONTROL

© X.H. Kramer, T.B. Kaiser, S.E. Schmidt, J.E. Davidson,
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Introduction

Reflexive control is a deliberate influence on an adversary with the goal of inclining him to make a decision predetermined by the controlling party. Such an influence has been practiced since ancient times, but until the 1960's, it had not been incorporated into a decision-making process as a regular component (Lefebvre, 1965). Not until the first models of an adversary's intelligence appeared, did it become possible to have at least rough estimation of the effectiveness of informational influence prior to its implementation. This achievement stimulated the development of new methods of informational influences and of new models of subjects who had mental representations both of the adversary and of the self. A concept of reflexive control had a significant impact on the manner in which the clash of two intelligences was studied. Traditional concepts of decision making consider to be obvious the idea that an adversary's intelligence is a non-controllable factor. A natural development of this idea is a paradigm of *prediction*: a decision maker tries to foresee the adversary's possible responses in various situations. Using reflexive control one can essentially narrow the frame of the paradigm of prediction by replacing it by the paradigm of *determining the future*. We will use the term *reflexive decision* for a decision that includes an informational message sent to an adversary.

In this paper, we describe some principles underlying generating reflexive decisions and illustrate these principles with specific computer programs developed by our team.

The Two Schemes of Reflexive Control

The general idea of reflexive control may be represented as shown in Figure 1. Suppose we have two sides, whom we will call Blue and Red. Suppose Blue wants to control the decision-making process of Red. To achieve this objective, Blue decides to send Red some package of information i. Blue also has a general model of Red that has been previously constructed. At the same time that Blue sends the package of information to Red, he puts it into his model of Red. This procedure is the equivalent of receiving some information about Red. Using this method, Blue can predict the decision process and behavior of Redin many cases, better than if Blue had not sent any information.
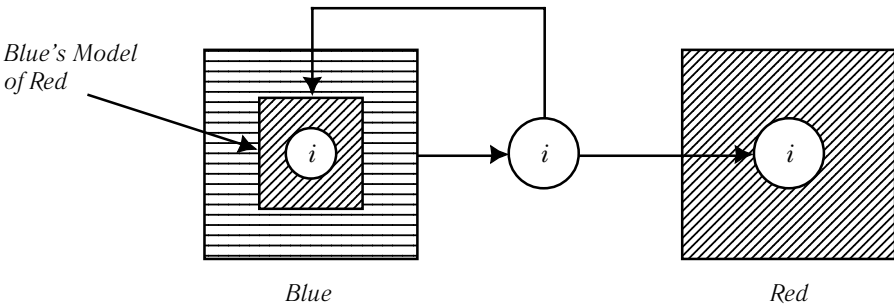
Blue's Model of Red

Blue

Red

Figure 1: Concept of reflexive control (Lefebvre, 1966, 1977)

Consider interaction of two parties, A and B; A tries to control B's decision-making process. Let S_A be a set of A's possible states and S_B be a set of B's possible states:

$$S_A = \{A_1, A_2, ..., A_i, ...\},$$
$$S_B = \{B_1, B_2, ..., B_j, ...\}.$$

Each state is characterized by a party's physical aspects such as spatial location, moves, and military actions.

In addition, A possesses a set of "tricks": sending an informational unit to the adversary:

$$T_A = \{T_1, T_2, ..., T_k, ...\}$$

We assume that while making decision A works along one of the schemes:

$$\text{(I)} \ A_i \rightarrow B_j \rightarrow T_k$$
$$\text{(II)} \ T_k \rightarrow B_j \rightarrow A_i$$

Consider scheme (I). Suppose A intends to move to state A_1, for example, to strike the enemy's left flank. But A's intention can be realized only if B moves to state B_j corresponding to concentration his forces at the right flank. B would concentrate his forces at the right flank only if he receives information that A

plans to strike the right flank. A's trick T_k consist of sending such an "informational package" to B which would persuade him to concentrate his forces at the right flank. Therefore, first A registers his intention A_i, then he determine the adversary state B_j which would allow A to realize his intention; finally, A chooses informational trick T_k moving B to state B_j.

Consider now scheme (II). First, A chooses trick T_k inclining the enemy to defend his right flank, which corresponds to B's move to state B_j; then A select plan A_i such that his actions will be the most effective.

A choice between the two schemes depends on many factors. Scheme (I), for example, can be chosen if A has only one intention that is possible to realize. Scheme (II) seems suitable for cases in which A has many intentions but only one effective trick transferring B into a certain state.

A Historical Example of the Use of the First Scheme of Reflexive Control (The 100-Hour War, 24 February 1991)

Begun on 24 February 1991 OPERATION DESERT STORM is an example of the use of the first scheme of Reflexive Control.

The first scheme of Reflexive Control posits a situation in which a military decision maker is limited to one alternative to solve a strategic, operational, or tactical dilemma. This was the case during Desert Shield/Desert Storm; we follow the account in (Schubert and Kraus, 1995). Because of the political necessity to end the ground campaign quickly and decisively and because of the dire need to limit allied casualties, General Schwarzkopf's options were limited. Armed with a model of Saddam Hussein, the Coalition Commander chose a plan that has become known as the "left hook." After developing plans for the "left hook," allied strategists used an effective "trick" to influence Saddam Hussein to make key decisions favorable to the allied course of action; the allies used the first scheme of Reflexive Control to perfection.

At the start the allies knew considerable information about their adversary. Saddam Hussein was not considered to be a "military genius"; they knew he was the central authority in all things and personally made militarily significant decisions about the deployment of his forces. The allies also knew, from studying the Iran-Iraq war, that Saddam Hussein tended toward static, positional warfare and that he trusted few of his generals aside from a handful leading the Republican Guard. Finally the allies added information to their model consistent with Saddam Hussein's penchant for secrecy and self-protection. It is no coincidence that the dictator kept his best and most loyal forces close to his breast and entrenched his poorly trained, poorly led conscripts in the desert along the border between Iraq and Saudi Arabia, exposed to the allied coalition.

Given the geo-political and strategic situation, the allied planners had no choice but to choose a scheme for an envelopment attack. The "left hook"

afforded the best chance to end things quickly and decisively. Now what remained was to find a good "trick" that Saddam Hussein could not resist.

In an effort to influence the decisions of Saddam Hussein, the allies used a feint by a U.S. Marine Expeditionary Unit (AFLOAT) off the coast of Kuwait City to reinforce Saddam Hussein's expectation that allied plans called for a direct attack on Kuwait City along the coastal highway. Hussein's belief rested on reports of a massive build-up of U.S. Marine, Egyptian, Syrian, and Saudi Arabian forces just south of the Saddam Defense Line on the coast of the Persian Gulf. The amphibious feint off of the coast of Kuwait City, the infiltration by U.S. Special Operations Forces on the beaches of Kuwait, and the massive build up of largely Arabic armored forces directly south of Kuwait City reinforced Saddam's expectations.

Meanwhile the U.S. XVIII and VII Corps moved approximately 300 miles to the west to prepare for an envelopment of the Iraqi Republican Guard. As a condition of the western movement of the two U.S. Corps, the allies had systematically dissected Hussein's command and control infrastructure while leaving him with the ability to see what he already believed to be true: the allies were building up south of Kuwait City and practicing amphibious assaults off of the coast in order to launch a direct attack northward along the coast. To prepare for the expected attack, Hussein ordered the repositioning of a significant number of Iraqi divisions closer to the coast and held the Republican Guard on the Iraq-Kuwait border between Kuwait City and Baghdad as his second line of defense and to protect himself.

In the end the allies "fed" Saddam the right kind of information to cause him to make military decisions favorable to the allies and favorable to their plan for an envelopment of Iraqi forces from far out of the west. One hundred hours later the war ended in an allied victory. Today, OPERATION DESERT STORM stands as one of the best examples of the use of the first scheme of reflexive control.

A Historical Example of the Use of the Second Scheme of Reflexive Control (The World War II North African Campaign: the Battle for Alam el Halfa)

We take our example of the use of the second scheme of reflexive control from the Army Field Manual (FM 90-2) (1988). Alam el Halfa, a ridge roughly 15 miles behind the Alamein line, was a natural stronghold. It was an excellent defensive position for the British at that stage in the war. It could, however, be outflanked by advancing Germans who might be able to attack on to Alexandria. The British maps of the area were excellent, being based on captured Italian maps corrected by aerial photographs. One type of British map was thought particularly valuable by both British and German armiesthe so-called "going map." This map showed color-coded regions denot-

ing how difficult the terrain was, and what speeds could be maintained by various vehicles.

The British decided to print a false "going map" showing that a flanking movement around Alam el Halfa would present rough going, whereas the route direct to the Alam el Halfa regions was easily possible. The map was secretly printed and placed in an armored car to be captured by the Germans. The plan worked and the Germans came directly to Alam el Halfa "(over rough going, incidentally)".

This example is illustrative of the use of the second scheme of reflexive control, in which a military decision maker possesses a "trick" and feeds the trick to his enemy to influence his enemy to take an action consistent with and favorable to the desires of the friendly decision maker. That is, the decision maker uses the trick to build his own course of action.

Automatized Generation of Reflexive Control

In this section, we give an example of a situation to which we may apply the two schemes of reflexive control discussed above and describe a program that allows us to compute reflexive decisions for this situation automatically. We imagine that the intelligence corps of a country, which we will call Blue, has received information that terrorists, whom we name Red, are going to attempt to smuggle a weapon of mass destruction into Blue. Blue intelligence has further determined that the terrorists will try to enter Blue through exactly one of n border regions, $X_1, X_2, ..., X_n$. In our implementation, we assume that there are three border regions (i.e., $n = 3$). However, for a systematic understanding of the method, it is important to consider the general case.

Blue decides to protect its borders by using reflexive control. Thus, Blue has to make a reflexive decision consisting of two parts: the *information* Blue should send the terrorists about how Blue's border defenses are deployed and how Blue should *actually deploy* its forces. For each border region, Blue may choose to deploy a High, Medium, or Low level of protection. Blue also publicly disseminates information about the level of protection in each border region; this public information is the informational package or trick. Naturally, the information Blue gives the public may not (and probably does not) match Blue's actual deployment.

In scheme (I), Blue intends to deploy its forces in a specific manner, and wishes to find a trick that will influence the terrorists to act in a manner that makes Blue's chosen deployment advantageous for Blue. This process is illustrated in Figure 2. We represent Blue's deployment by a vector $D = (d_1, K, d_n)$, where d_i is the level of deployment in region X_i. We assume that Blue has an initial priority order $<_b$ on the regions such that $X_1 <_b \Lambda <_b X_n$. Red also has an initial priority order $<_r$ on the regions such that $X_{i_1} <_r \Lambda <_r X_{i_n}$. Blue then models

Red's border crossing attempts and computes Red's probable rate of success s_i in each region X_i, given deployment D. This step is necessary because the level of Blue's defense is not the only factor which influences the success or failure of a Red border crossing attempt; we must also take logistical concerns such as terrain difficulty and the need for particular resources into account. (We discuss the details of the border crossing model below.) Using these success rates, Blue determines a *preference order* $<_B$ on the regions, which is defined as follows:

$$X_i >_B X_j \quad \text{if } s_i < s_j, \text{ or}$$
$$\text{if } s_i = s_j \text{ and } X_i >_b X_j.$$

Suppose $X_{j1} <_B \Lambda <_B X_{jn}$. So region X_{jn} is Blue's first choice for Red's border crossing attempt, as Red's probability of success is lowest in there. We may view this order as giving a permutation π on the set $\{1,K,n\}$ by setting $\pi(h) = j_k$. We may now write Blue's preference order as a vector $P = (p_1,K,p_n)$ with $p_k = \pi^{-1}(k)$. This vector is called *Blue's preference*.
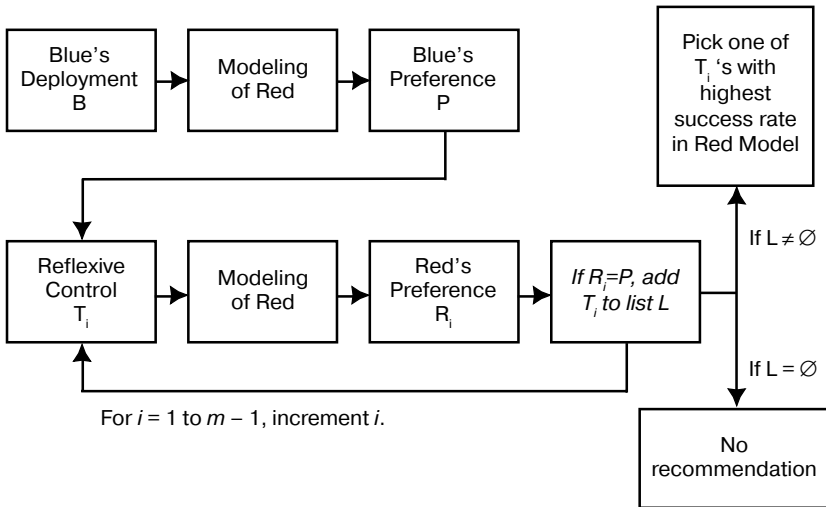

Figure 2: Scheme (I)

We call the information Blue sends the terrorists about how Blue's defenses are deployed a *trick*. We may write a trick as a vector $T = (t_1,K,t_n)$ where t_i is the level of deployment Blue *claims* to have in region X_i. Suppose Blue has a list of tricks $\Lambda = \{T_1,K,T_m\}$ available. For each trick T_i, we may establish Red's *preference order* $<_i$ in a manner similar to the computation of Blue's preference order. Assume Red accepts the trick and believes Blue's forces are actually deployed as the trick indicates. We now use our border crossing model to repre-

sent Red's process of scouting the border and determining a probable rate of success s_{ij} for each region X_j. We then define $<_i$ by

$$X_j >_i X_k \quad \text{if } s_{ij} > s_{ik}, \text{ or}$$
$$\text{if } s_{ij} = s_{ik} \text{ and } X_j >_r X_k.$$

As before, we may write $<_i$ as a vector R_i.

Blue would like to find those tricks T_i for which his actual deployment D is most advantageous. That is, Blue wishes Red to believe that his chances for success are high where they are in fact low, and vice versa. We implement this idea by looking for those tricks for which $R_i = P$. This criterion means that Red prefers regions in an order exactly the reverse of the order of his likelihood of success in them! Let L be the list of all such tricks in Λ. If $L \neq \varnothing$, we pick the trick T_k such that

$$\sum_{j=1}^{m} s_{kj} \geq \sum_{j=1}^{m} s_{ij} \quad \text{for all i} = 1, K, m.$$

If there is more than one such trick, we pick one of them randomly. If $L = \varnothing$, then the system gives no recommendation.

Example. Suppose, for instance, that Blue wishes to deploy a High level of protection in Region X, but leave Regions Y and Z relatively unguarded with Medium and Low levels of protection, respectively. (It may be that higher levels of protection for these regions are prohibitively expensive, for example.) Now suppose Blue calculates that Red's success rates for regions X, Y, and Z, are .375, .125, and .5, respectively. Then Blue's preference order is $Y > X > Z$. So in this case, Blue would like the terrorists to chose to come through Region Y and avoid Regions X and Z; thus, Blue looks for a trick that will influence the terrorists to make this choice.

Blue looks for tricks that result in Red's preference order matching Blue's, and compiles a list L of such tricks. Finally, Blue chooses the trick T_k that will appear to Red to give the greatest probability of success overall.

In Scheme (II), Blue does not have a specific deployment in mind. Instead, he evaluates all possible tricks, looking for those that will influence the terrorists to act in a way that Blue can effectively counter. Scheme (II) is illustrated in Figure 3.

For each trick T_i, Blue establishes Red's preference R_i as above. Then Blue determines the best deployment B_i he can afford, as follows. Let H denote a high level of deployment; M, a medium level; and L, a low level. We assume Blue has a total bound on cost C, and for each region X_i and level of deployment $d \in \{H, M, L\}$, a known cost $C_{i,d}$. Suppose Red's preference order is $X_{k1} >_i \Lambda >_i X_{kn}$. Blue wishes to use the highest level of deployment he can afford in Red's first choice region, X_{k_1}, but he also wants to ensure that no region is

left completely undefended, that is, the must be at least a low level of deploy-ment in every region. (Thus, we make an initial assumption that $\sum_{p=1}^{n} C_{k_p,L} \leq C.$) So Blue chooses d_1 to be the highest level of deployment that does not exceed his cost bound and leaves enough money to cover the remaining regions with at least a low level of deployment.
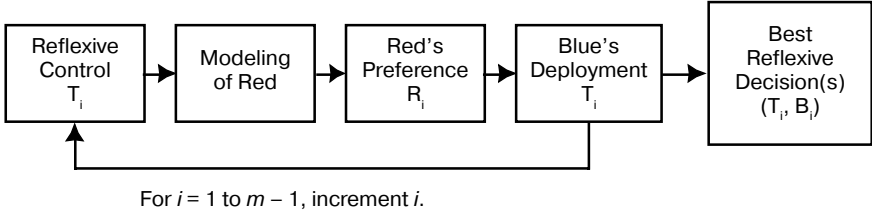

For i = 1 to m − 1, increment i.

Figure 3. Scheme (II)

More formally, we let d_1 be the highest level of deployment such that

1. $C_{k_1,d_1} \leq C$ and
2. $\sum_{p=2}^{n} C_{k_p,L} \leq C - C_{k_1,d_1}$.

Blue chooses d_2 similarly, with new cost bound $C - C_{k_1,d_1}$. So, in general, for each region X_{k_1}, we let d_j be the highest level of deployment such that

1. $C_{k_j,d_j} \leq C - \sum_{p=1}^{j-1} C_{k_p,d_p}$ and
2. $\sum_{p=j+1}^{n} C_{k_p,L} \leq C - \sum_{p=1}^{j} C_{k_p,d_p}$.

We may represent the deployment B_i as an n-digit ternary number N_i by putting the jth digit equal to 2 if $d_j = H$, equal to 1 if $d_j = M$, and equal to 0 if $d_j = L$. The system then recommends those reflexive decisions (T_i, B_i) for which $N_i \geq N_j$ for all $j = 1, \ldots , n$.

An essential component of Blue's decision-making process is a model of how Red will respond to an informational package (trick) sent by Blue. In this situation, we use a model of border penetration in multiple regions. We as-sume that the terrorists will scout several possible routes across the border in each region, ultimately attempting the smuggling operation through the re-gion that they conclude they have the greatest probability of successfully pen-etrating. To model this behavior, we map out possible routes across the border in each region. We identify key locations in each region, and possible paths between them. Thus, each route may be thought of as a travel itinerary through a sequence of key locations. Each leg (i.e., path between two key locations) is assigned two ratings. The first rating reflects the logistical difficulty of the path, and the second represents the probability that the terrorists will be apprehend-

ed on this path. This second rating will of course be affected by the protection level of the region. Since Blue wishes to see how Red will respond to the disinformation of Blue's trick, we refer to the level of protection given in this informational package. We may then simulate a terrorist attempt to penetrate a border region by following a particular path. (Details will be discussed in the next section.) To reflect the idea that the terrorists will initially scout the border to improve their probability of success, we start with an initial set of border crossing routes and use elements of genetic algorithms (namely, fitness-proportionate reproduction, crossover, and mutation) to generate routes which may be more successful than this initial set. Using this model, Blue may determine what Red's preference order will be in response to a particular trick.

Simulation of an Adversary's Thinking Process

We consider that an adversary is not a single human being but a special macro-individual who has at his disposal strategic and tactical information at a scale of a large military headquarters, who can estimate the difficulty of performing various actions and the risk accompanying them, and who is capable of imitating his adversary's possible counteractions. In addition, we assume that this macro-individual can replay the same situation many times in his mind with various parameters, which allows him to obtain statistical characteristics of his action's success. We also think that this creature is rational; that is, it chooses versions of the actions which seem most useful. In this section, we describe how we simulate Red's thinking about his options in attempting to penetrate Blue's border defenses.

Each border region is modeled as a network. Key locations in the region are identified; these locations are represented as nodes in the network graph. There is a link between two nodes if it is possible to move directly, say via road or ferry crossing, between the locations corresponding to the nodes.

As an example, in Figure 4 we show the Pacific Northwest region of the Canada/United States border, with nodes marked. Each node represents a specific location or area in the United States or Canada. Figure 5 shows the network we constructed for this region. The key for the node labels is as follows: in Canada, V = Vancouver, BC = British Columbia mainland outside Vancouver, Sa = Saltspring Island, and on Vancouver Island, Na = Nanaimo, SB = Swartz Bay, Si = Sidney, Vi = Victoria, and PR = Port Renfrew. In the United States, all locations are in Washington state, and Bl = Blaine, Ly = Lynden, Su = Sumas, Be = Bellingham, Oso = Oso, An = Anacortes, Sea = Seattle, and PCT = the Pacific Crest Trail. On the Olympic Peninsula, PT = Port Townsend, PA = Port Angeles, and Sek = Sekiu. On the islands in the Strait of Juan de Fuca, FH = Friday Harbor and Ea = Eastsound. The link from FH to An, for example, represents the fact that there is regular ferry service between these two points.

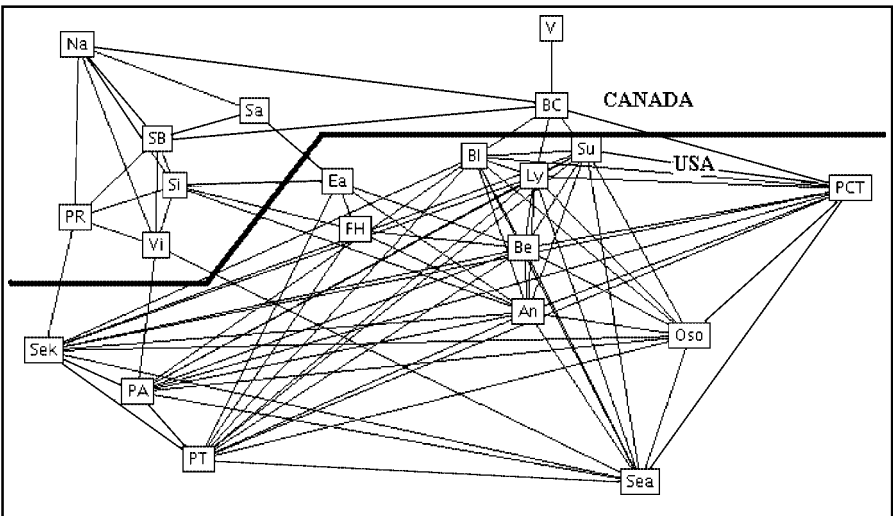*Figure 4: Pacific Northwest region on Canada/United States border*

Figure 5: Network graph for Pacific Northwest region

Each link in our network graph is assigned a *risk r* and *difficulty d*. Determination of key locations, the placement of links, and appropriate values for risk and difficulty are domain analysis decisions. Model resolution is controlled by these decisions; for example, identifying more key locations gives a model of finer resolution than one representing fewer locations in the network graph. We will assume that the network is constructed in such a way that the network graph is connected.

For an agent to successfully penetrate the border, it must move via the network from a designated *starting location* to a *goal location*. When the agent attempts to traverse a particular link, the difficulty *d* of that link gives the probability that the agent will fail, and thus remain at its current location for another time step. The risk *r* gives the probability that the agent will be captured as it tries to move. For the Pacific Northwest region, we designate Vancouver as the starting location and Seattle as the goal location.

We use a genetic algorithm to evolve successful border penetration strategies for the agent. (For a general discussion of genetic algorithms, see Koza (1992).) A strategy for the agent is a path from the starting location to the goal location. Each node in the network graph is labeled. We will assume that there is at most one link between any pair of nodes; thus, any link may be identified by specifying the nodes which it connects. Let *n* be the number of nodes; we will assume that the node corresponding to the starting location is labeled v_0, and the node corresponding the goal location is labeled v_n. So the agent's strategy may be represented by a sequence of nodes, beginning at v_0 and ending at v_n. So, for example, one possible path in the network graph for the Pacific Northwest region is V BC SB Vi Sea. The ideas we discuss in this section may be easily extended to cases where the network graph may have more than one link between a pair of nodes. For such a graph, we would label both nodes and links, and represent paths by a sequence of alternating nodes and links.

Suppose we decide to run the Border Penetration Simulation for *T* time steps. Agents which do not make it from v_0 to v_n in *T* time steps will be considered to have failed in their mission.

To produce paths for the first generation for the genetic algorithm, we first find all *reasonable paths* from the start node to the goal node. A reasonable path is one which does not repeat any nodes and avoids unnecessary detours which increase the overall risk or difficulty of the path. To describe what we mean by an "unnecessary detour," we note that there are areas of a given border region in which Red might reasonably suppose risk and difficulty to fairly constant. Thus, Red assumes that the weights (for both risk and difficulty) assigned to links in the part of the network graph corresponding to such a region do not vary significantly. Thus, for a given entry and exit node to a region, an optimal path through such a homogenous region will be a path of shortest

possible distance through that region. For example, in the Pacific Northwest region, we assume that the Washington state mainland is such a region since there are roads between any two locations and there are no border crossings. So the path V BC Su An Sea has an unnecessary detour to An, while the path V BC Su Sea contains no unnecessary detour.

Once we have found all reasonable paths, the first generation for the genetic algorithm is determined by selecting randomly among these reasonable paths, allowing repetition.

Let G be the network graph, and let $V(G)$ be the node set of G. To describe the crossover operation for the genetic algorithm, suppose we have two strategies σ, τ to cross. Suppose

$$\sigma = v_0 \, v_{i_1} \, v_{i_2} \ldots v_n$$

where each $v_{i_k} \in V(G)$. Let c be the number of nodes other than v_0 or v_n that σ and τ have in common. If $c = 0$, then simply replicate (rather than cross) σ and τ. For $c > 0$, randomly choose a common node v_{i_q} other than v_0 or v_n as the position for the crossover cut. Thus σ is split into two pieces: an initial segment from v_0 to v_{i_q} and a terminal segment from v_{i_q} to v_n. Similarly, the strategy τ is split into an initial and terminal segment. Our two new strategies are thus a strategy σ' with initial segment the initial segment of σ and terminal segment the terminal segment of τ, and a strategy τ' with initial segment the initial segment of τ and terminal segment the terminal segment of σ. To apply mutation to a strategy σ, we simply replace it with a new strategy σ' which is generated in the same manner as our initial set of strategies.

The actual run of an agent or group of agents through the Border Penetration Simulation with strategy s works as follows. Suppose

$$\sigma = v_0 \, v_{i_1} \, v_{i_2} \ldots v_n$$

where each $v_{i_k} \in V(G)$. The agent attempts to move through G following the path given by σ, traversing one link per time step. Suppose at time step t, the agent is at v_{i_s} and attempts to the traverse link between v_{i_s} and $v_{i_{s+1}}$. Then that link's associated difficulty is the probability that the agent will fail to move across the link, in which case the agent will remain at v_{i_s} at time step $t+1$ if it is not captured. The link's associated risk is the probability that the agent is captured, in which case the simulation ends, and the agent's final position is v_{i_s}.

The evaluation of fitness for agent strategies is based on how close the agent is to the goal node at the end of the simulation. For any $v_i \in V(G)$, let $L(v_i)$ be the length of the shortest path in G from v_i to v_n. If $L(v_i) > L(v_j)$, we say that v_i is further from v_n than v_j is. Let $L = \max\{L(v_i) | v_i \in V(G)\}$; that is, L is the length of the shortest path from the node that is furthest from the goal node to the goal node. Suppose an agent a with strategy σ is at node v_i at the

end of the simulation. We will denote the fitness of agent a with strategy σ by $F(a,\sigma)$, and define

$$F(a,\sigma) = 1 - \frac{L(v_i)}{L}.$$

So an agent a with strategy σ is judged more fit than an agent b with strategy τ when $F(a,\sigma) > F(b,\tau)$.

To create the next generation of strategies, we first apply fitness-proportionate reproduction to create a mating pool, and then select strategies from this mating pool for crossover and mutation. Suppose we have agents a_1, a_2, ..., a_N with associated strategies σ_1, σ_2, ..., σ_N. To apply fitness-proportionate reproduction, we compute $F(a_1,\sigma_1)$, $F(a_2,\sigma_2)$, ..., $F(a_N,\sigma_N)$ and their sum $\sum_{k=1}^{N} F(a_k,\sigma_k)$. Each of the N strategies in the mating pool is selected from the strategies σ_1, σ_2, ..., σ_N with the probability that strategy σ_i is chosen being

$$\frac{F(a_i,\sigma_i)}{\sum_{k=1}^{N} F(a_k,\sigma_k)}.$$

The selection of each strategy for the mating pool is made independently, and we allow repetitions.

Once the mating pool is established, a fixed percentage p_c of these strategies are selected for crossover and paired randomly. Note that p_c must be set so that an even number of strategies are chosen for crossover. Another p_m percent are selected for mutation. The remaining strategies are not changed. Once the crossover and mutation operations are performed, we have the next generation of strategies.

Figure 6 displays the output of an actual implementation of scheme (II) in a computer program. The highlighted row in the table contains the reflexive decision

$(T4,B4) = ((\text{Low,Medium,Low}), (\text{Medium,Low,High}))$

that is suggested as best by the computer system. Every possible trick is evaluated by running the algorithm described above to model the adversary's judgment of the situation. Risk values are modified according to the current trick where High adds 0.3 to the risk value of each edge crossing the border, Medium adds 0.15, and Low adds nothing. On the modified graph we run ten generations of the genetic algorithm as described above. We measure the success rate for each region by the ratio between the number of times the simulated terrorists reach the goal in the final generation and the total number of paths per generation. Our model of the adversary gives now a strict preference order on the different regions: our adversary's first choice will be the region with the highest success rate. If two regions have the same success rate, we assume the adversary prefers the one with the higher priority number as

given in the initial setup of the run. The adversary's second choice is the one with second highest success rate, and his last choice is the region with the lowest success rate.
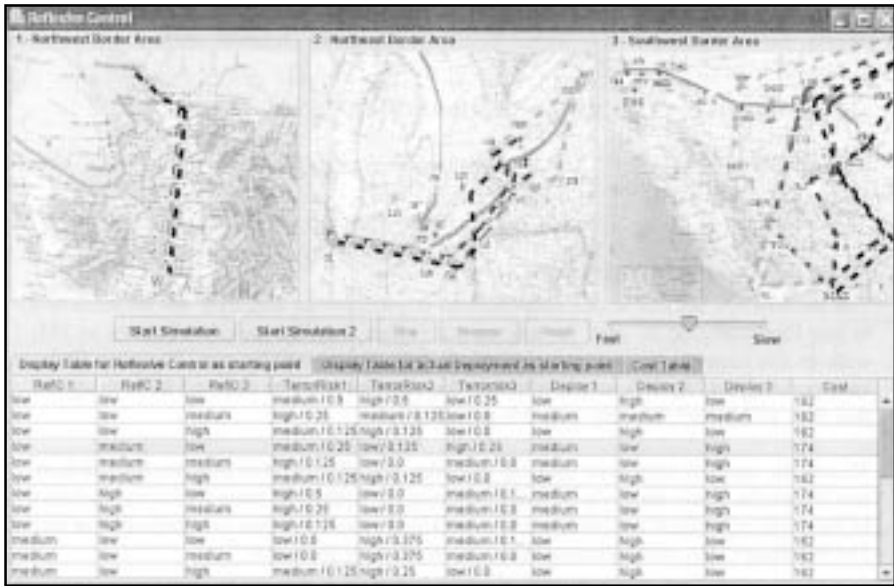

Figure 6: Screenshot

Assuming that the adversary will act according to this preference order, we compute a counter-strategy. For each region, we give the cost for each level of deployment in the setup of a run, as well as a maximum total cost. We use these cost values to compute the highest level of deployment we can afford, starting with Red's first choice region. The system recommends the highlighted reflexive decisions. We regard a deployment as a three digit ternary number in the following way: the first digit corresponds to the region of Red's first preference; the second digit, to Red's second preference; and the third digit, to Red's last preference. If deployment in a region is High the corresponding digit is set to 2, for Medium to 1, and for Low to 0. So, for example, the highlighted one in Figure 1 has the ternary number 210 (which equals 21 in decimal). We highlight the rows in which this ternary number is maximal for the run.

Conclusion

The methods of reflexive control described above can be successful only under the condition that the party which is being controlled does not know about this fact. Otherwise, reflexive control can damage the controlling party, since

after discovering a trick, the controlled party may reconstruct the intentions of its opponent.

Let us return to the model of border penetration. Suppose, following the first scheme of reflexive control, that Blue intends a deployment D that results in a Blue preference order $Z >_B Y >_B X$. So Blue sends Red a trick T_i, which, if Red accepts this information, will result in a Red preference order $Z >_i Y >_i X$. In this case, the terrorists, would, probably, make a decision to cross the border in region Z, i.e., at the location where they have the lowest probability of success. Consider now a case of trick failure: Red realizes that their order of preferences is the result of the enemy's hidden actions. It is natural to suppose that the understanding of this fact will lead to a reversed order of preferences: region X will become the most attractive, then region Y, and region Z will be the last. In this case, Red would most likely decide to cross border in region X, where Blue's defense is least effective. And this is the danger involved in the failure of reflexive control.

Let us pose a question: could the Blue side insure themselves, at least partially, against the failure of their trick? The answer is yes. Suppose, instead of using trick T_i, Blue employs a trick T_j such that if Red accepts this information, the resulting Red preference order is $Z >_j Y >_j X$. Then if the trick works, the terrorists will attempt their border crossing in region Z as before, which is the best possible outcome for Blue. But now if the trick fails, Red's preference order $\prec_j$ will be $Y \succ_j X \succ_j Z$. So Red will choose to cross the border in Y, which is *not* the outcome least favorable to Blue. Thus the Blue side avoids the worst-case scenario by modifying the trick they use.

This idea can be applied to any number of regions. Suppose we have some number n regions labeled X_1, ..., X_n and that Blue intends a deployment D that results in a Blue preference order $X_n >_B X_{n-1} >_B ... >_B X_1$. Now Blue wishes to find a trick such that if Red accepts this information, Red will attempt a border crossing in the region most advantageous for Blue; but if the Red side suspects they are being deceived, the outcome will still not be too bad for Blue. So Blue picks a trick T_j that, if Red accepts the information, will result in a Red preference order that matches not Blue's preference order, but what we may term a Blue "hedging order." To describe the hedging order, we think of the order as consisting of n slots, with the region highest in the order being placed in the 1st slot, the second highest region being placed in the 2nd slot, and so on, with the region lowest in the order being placed in the nth slot. Now we place X_n in the 1st slot; X_{n-1}, in the nth slot; X_{n-2}, in the 2nd slot; and X_{n-3}, in the $(n-1)$st slot, as shown:

slot number:	1	2	...	$n-1$	n
region:	X_n	X_{n-2}	...	X_{n-3}	X_{n-1}

We continue in this way down the Blue preference order, alternating between the highest available and lowest available slots in the hedging order, until all regions are assigned a slot in the hedging order.

Now if Red accepts the information in the trick T_j, the terrorists will choose to attempt their border crossing through region X_n, which is the best possible outcome for Blue. But if the trick fails, Red will attempt the border crossing through region X_{n-1}, the second best outcome for Blue. Thus Blue has successfully "hedged his bets."

To apply the idea of hedging when using the second scheme of reflexive control, let us suppose that Blue has decided to employ a particular trick T_i which, if it succeeds, will result in a Red preference order $X_n >_i ... >_i X_1$. To guard against the possibility of trick failure, Blue will determine his deployment not by using this Red preference order, but by using a hedging order. In this case, we fill slots in numerical order by alternating between previously unchosen regions which are highest in the Red preference order, and those which are lowest. The resulting hedging order $\prec_B$ is

$$X_n \succ_B X_1 \succ_B X_n–1 \succ_B X_2 \succ_B ... .$$

So if Blue's trick works, Red will attempt a border crossing in region X_n, where Blue has the strongest defense; otherwise, Red will attempt region X_1, where Blue has the second strongest defense.

In the above analysis, we in fact used the following assumption about Red's mental domain:

1. Red are able to realize that their order of preferences are imposed on them by Blue.

2. This realization reverses their order of preferences.

3. Red cannot realize that Blue take into consideration the possibility of failure of reflexive control.

The concept of reflexive control has a clear connection with Shannon's information theory. Suppose Blue knows that Red has n alternatives ($n > 2$) and that Red has established a strict order of preferences, which is unknown to Blue. There can be $n!$ orders on a set of n alternatives; thus, Blue's uncertainty of knowledge about Red's order of alternatives is $\log_2 n!$ bits. Suppose Blue performs a trick, but he doesn't know whether it was successful or not. In this case, if Red's mental domain is described with the three conditions given above, Blue's uncertainty of knowledge about Red's order of alternatives is equal to one bit. Therefore, as a result of reflexive control, Blue obtained $\log_2 \dfrac{n!}{2}$ bits of information.

In conclusion, we have to note that the areas of application of the methods described cannot be devised without special psychological experiments.

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ESSENTIAL SINGULARITY STRUCTURE OF MULTI-ATTRIBUTE UTILITY FUNCTIONS

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Introduction

The information age need for the development of automated decision support systems to assist people in making decisions that affect a broad range of endeavors has focused renewed interest on the theoretical underpinnings of decision models. Much of the theoretical work in decision analysis in the US over the last few decades has been dominated by game theory (the expected utility concept of von Neumann and Morgenstern[1] and its extensions into the multi-attribute domain by Keeney and Raiffa[2]). This approach results in a mathematical function called a multi-attribute utility function (MAUF) that purports to be a measurement of the overall utilities of a range of decisions regarding objects with multiple attributes. Ideally, the MAUF is determined via eliciting the decision agent's[i] preferences (or lack thereof) among lotteries (one of which may or may not be a sure thing) involving different values of the attribute variables with a controlled probability distribution of the winning payoff options.

The MAUF approach, however, is not without its problems. Foremost among these is that the elicitation process for the general case MAUF is tedious and time consuming. When the attribute variables are defined over a continuum of values, an infinite amount of information is required to determine the MAUF (in principle). Even when the attribute values are defined on a discrete set of attribute categories, the combinatorics of the elicitation process can be daunting. To simplify the elicitation process it is often the case that assumptions are made regarding the analytic structure of the MAUF. Assum-

ing that the MAUF is a weighted linear additive combination of single attribute utility functions and their products, for example[2], leads to a simple and straightforward elicitation procedure, but may overly constrain the mathematical structure of the MAUF. Possibly because of such simplifying assumptions the elicitation process for the MAUF has developed into something of an art form. An element of this "art" is that the elicitation process terminate when "just enough" information is acquired to determine an MAUF. Asking extra questions about preferences between attribute variable sets has been found to lead to MAUF that violate the original assumptions about MAUF structure. This puts a premium on "asking the right questions" in pursuing this art form. This has led some critics to conclude that MAUF are usually more assumed than measured[3].

Another characteristic of MAUF that deserves consideration is their individuality. The ordering of preferences that results from the elicitation process is unique to each individual decision agent. It is his utility that is being measured and no one else's. In MAUF theory, however, there is no guidance regarding the preference choices. One agent may order his choices with careful attention to the world pressures characterizing his situation while another may be driven almost entirely by personal motives. Ethical considerations may play a large role for the preference choices of some agents (in some situations) and not for others. This leaves open the possibility of agent preference choices that are self-destructive and/or self-defeating and calls into question the use of the word utility in current MAUF theory. The thesis of this work is that the reflexive human decision model of V. Lefebvre[4] and variations thereof[5] may be usefully employed to design an MAUF elicitation procedure that is less subject to criticisms of this sort. Furthermore, the reflexive MAUF approach enables the determination of a singularity structure of the MAUF that we will argue is "essential" for any MAUF of a real human decision agent possessed of free will and freedom of choice.

Expected utility and lotteries

In order to introduce these utility concepts and elucidate the role played by lotteries in defining utility functions, a simple hypothetical problem of free market economics will be analyzed. Consider an entrepreneur who is the owner/operator of an ice cream stand whose sole product line has consisted of

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The author has been chided by Russian friends for using the word "agent" instead of the word "subject," which is their preferred English translation of the Russian equivalent. Here we continue to employ the word agent with the intended meaning of "one who is empowered or has the authority to make decisions." The intended connotation is that of the "autonomous agent" of Complex Systems Science rather than the "behavioral agent" of the rightfully discredited field of Behavioral Psychology. In English the word "subject" has the undesirable (for the present purposes) connotation of one who is under the authority of another or one upon whom an experiment is conducted.

cones filled with either low fat frozen yogurt (which he sells for $1.50) or plain vanilla ice cream (which he sells for $2.50). Assume that these prices have been determined by trial and error marketing principles over an extended period and that they represent prices that maximize the entrepreneur's profits under the constraints of his supply situation and customer base. By introducing a Boolean variable S defined on the domain (0,1) where 0 signifies the choice of the low fat frozen yogurt cone and 1 signifies the choice of the plain vanilla ice cream cone, the utility function of the entrepreneur's product line may be written:

$$U(S) = \$1.50\delta_{S,0} + \$2.50\delta_{S,1} \tag{1}$$

Here the Kronecker delta symbol is employed to express the functional dependence on S. The problem that the entrepreneur faces is the determination of the correct prices to charge for two additions to his product line. Let's assume that he has purchased the equipment needed to offer either the yogurt or ice cream cones with a chocolate coating (called dipped cones) as an option and also secured a supply contract for the needed extra ingredients (chocolate syrup and edible paraffin wax). After consideration of the unit cost of his extra supplies and the amortization of the cost of the extra equipment over its expected lifetime, the entrepreneur estimates that it will cost him an extra $0.19 to add the chocolate dip to either of his cones.

The entrepreneur decides to adopt a scientific approach to determining the correct market prices to charge for his dipped cones. For a two-week period he offers those customers who order plain vanilla ice cream cones (PVICC) a choice: they can either get what they ordered (for $2.50) or they can enter into a lottery (also costing them $2.50) with a known probability of winning and roll a pair of dice. Should they choose the lottery and win at the dice roll, they get the PVICC dipped in chocolate. Should they choose the lottery and lose, they get instead the low fat frozen yogurt cone (LFFYC). Each day of the two-week period the entrepreneur fixes (by specifying a given set of winning dice rolls) and posts the probability of winning the lottery. His goal in changing the winning probability is the determination of the value at which half of his customers choose to get what they ordered (PVICC) while half choose the lottery. Toward the end of his two-week trial he determines that the winning probability (fraction) that satisfies this fifty-fifty split is $x_{50\%} = 0.67$. He now reasons that the expected utility of the PVICC ($2.50) should be equivalent to the expected utility of the lottery with winning probability of $x_{50\%}$. The expected utility of the lottery, however, is the probability of winning times the value of the winning prize (the unknown value of the dipped PVICC) added to the probability of losing times the value of the losing prize (LFFYC).

$$\$2.50 = x_{50\%}P_{PVICC-DIPPED} + (1 - x_{50\%})\$1.50 \tag{2}$$

The entrepreneur easily solves this equation for the unknown value of the dipped PVICC (which he determines to be $P_{PVICC\text{-}DIPPED}$ = $2.99).

Noting that this price represents an extra $0.30 profit margin for each dipped cone that he sells, the entrepreneur happily fixes the price of dipped PVICC at $2.99 and adds it to his menu. He also assumes that the price differential for adding the chocolate dip should be the same when applied to the LFFYC and fixes that price at $1.99. Over the next few weeks he enjoys the extra profits from the sale of dipped cones, but notices that the fraction of his LFFYC customers who choose the dip option is much smaller than that of his PVICC customers. He begins to question his assumption regarding the pricing of the dipped LFFYC and calls in a business consultant. The consultant (who happens to be an expert in game theory) explains that just because his unit cost for adding the chocolate dip is the same for the PVICC and the LFFYC does not mean that they have the same value to his customer base. The consultant suggests another lottery to determine the correct market price of the dipped LFFYC. The details of this lottery are the same as the previous lottery except that the losing prize is now a dipped LFFYC. After conducting another two-week experiment, the entrepreneur determines the winning probability that results in a fifty-fifty split to be $x_{50\%}$=0.59. He repeats his game theory analysis:

$$\$2.50 = x_{50\%}\, \$2.99 + (1 - x_{50\%})P_{LFFYC-DIPPED} \tag{3}$$

and determines the correct price for the dipped LFFYC to be $P_{LFFYC\text{-}DIPPED}$ = $1.79. After changing his menu to reflect this new price, he notes a considerable increase in profits from the sale of dipped LFFYC and understands that he must accept a smaller unit profit margin for the dip option on LFFYC ($0.10) in order to maximize his profits overall. By introducing another Boolean function D whose value signifies whether (1) or not (0) the chocolate dip option is chosen, the entrepreneur is able to define a new product utility function:

$$U(S, D) = U(S) + U_{CD}(S, D) \tag{4}$$

The function $U_{CD}(S,D)$ is the single attribute utility function for the chocolate dip option:

$$U_{CD}(S, D) = \delta_{D,1}(\$0.29\delta_{S,0} + \$0.49\delta_{S,1}) \tag{5}$$

In performing the above analyses the entrepreneur has slightly perverted von Neumann's expected utility and lottery concepts. The original concept of a utility function was that it measured the utility of an attribute for a single individual and the winning probability of the lottery was adjusted until that individual had no preference between playing the lottery or not. The entrepreneur extended these concepts to his "average customer" and interpreted the fifty-fifty split of the customer base as an absence of preference over whether or not to play the lottery.

Utility functions for objects with multiple attributes

The complications of measuring utility functions of objects with multiple attributes will be introduced by continuing this simple marketing exercise. Suppose now that the entrepreneur is planning to further extend his menu options by adding a cherry topping to his PVICC and LFFYC selections. He correctly reasons that he can determine the fair market values of the cherry topping added to either the PVICC or LFFYC with exactly the same series of lottery experiments as used with the chocolate dip option. He determines a single attribute utility function for the cherry topping option defined in terms of a new Boolean variable T whose value signifies whether (1) or not (0) the cherry topping option is chosen ($U_{CT}(S, T)$). We need not specify an exact functional form for this function to satisfy our purposes here. His problem now consists of determining how to price his cones when the customer wants both the cherry topping and the chocolate dip options. His first impulse is to simply price those selections by adding together the unit price differentials for the two separate options onto the base prices of his PVICC and LFFYC selections,

$$U(S, D, T) = U(S) + U_{CD}(S, D) + U_{CT}(S, T) \ ? \tag{6}$$

but his initial experience with pricing the dipped LFFYC suggests that this may not be a profit maximizing strategy.

A further indicator of a possible failure of the additive pricing strategy of Eq. (6) results from the entrepreneur's reflections upon a small bit of history. He remembers that during his childhood a candy firm (that has long since gone out of business) used to offer for sale a special confection during the winter holiday season; chocolate covered cherries. No other candy-maker chose to offer this special holiday confection after the original firm went out of business, and the entrepreneur realizes that his extended menu options will effectively recreate this remembered taste sensation. Being an astute student of game theory by this point, the entrepreneur suspects that the nostalgic value of the combination of the chocolate dip and the cherry topping will significantly exceed the sum of the price differentials of these two options taken separately for his customer base. Unlike the situations encountered when the fair market prices of the separate options were being determined, there are now not one but several choices for designing a series of lottery experiments to determine the unknown values of the option combinations. The question now facing the entrepreneur is which lottery experiments to choose. In general a successful lottery experiment usually (although not always) involves offering a choice between a "sure bet" and a lottery with the value of the "sure bet" being intermediate between the values associated with winning and losing the lottery. This combinatorial situation also does not preclude more complex lottery experi-

ments wherein the prize for winning the lottery is a chance to play another lottery. The level of complexity of such problems increases explosively as the number of attributes increases.

In the 1970s Kenney and Raiffa[2] sought to bring some order to this complexity by proposing a general form for multi-attribute utility functions. For the case of our simple marketing example, their proposal corresponds to a product utility function:

$$U(S, D, T) = U(S) + U_{MAUF}(S, D, T) \tag{7}$$

where $U_{MAUF}(S, D, T)$ is a multi-attribute utility function defined as follows:

$$U_{MAUF}(S, D, T) = aU_{CD}(S, D) + bU_{CT}(S, T) + cU_{CD}(S, D)U_{CT}(S, T) \tag{8}$$

Any three independent lottery experiments would be sufficient to determine the values of the unknown coefficients (a, b, c) in Eq. (8) and completely specify the multi-attribute utility function. Practitioners who sought to apply this technique to real world problems soon discovered that the values of these unknown coefficients were not unique, but depended to some extent on the specific lottery experiments chosen to determine them. It remains unclear today whether this lack of uniqueness represents experimental error in the lottery experiments or a fundamental flaw in the Keeney/Raiffa MAUF procedure. Here the latter possibility will be explored.

Reflexive models of multi-attribute utility functions

The reflexive decision models were originally developed as alternatives to the Game Theory procedure. Lefebvre's model[4] of reflexive human decision is based not only upon utility (which we will associate with the world's pressure on the decision agent) but also upon polarity (which may be subconsciously assigned by the decision agent in some situations) and that introduces ethics, prejudice, and bias (depending upon one's perspective) into the decision process. Furthermore, the world pressure of the situation is subdivided into that part of which the decision agent is consciously aware (x_2) and that part of which the decision agent is not consciously aware (x_1). Lefebvre also pays more attention to the definition of preference than is commonly done in MAUF theory. He introduces a preference variable (x_3) that reflects that part of the decision agent's preference that is independent of the world pressures and distinguishes it from the actual decision probability $f(x_1, x_2, x_3)$ (to choose the positive pole). Unlike the decision models of the MAUF approach, reflexive decision models describe binary choices that incorporate both world pressures and personal preference. Our MAUF model could be expressed as a chain of binary choices: 1) whether to buy LFFYC or PVICC, 2) whether or not to add the cherry topping option, and 3) whether or not to add the chocolate dip option, each of which would require its own reflexive model. For choice number 1, for

example, account would have to be taken of the fact that some of the customer base would assign the positive pole to the PVICC choice because of their taste preference, while others might assign the positive pole to the LFFYC for reasons of health consciousness. The world pressures influencing their decisions might include their degree of hunger, the amount of money they have to spend, and food allergies to chocolate or perhaps the red dye they know to be used in the cherry topping. Each individual will possess different world pressure and preference values for each of these binary choices and will respond to these via Lefebvre's reflexive model:

$$f(x_1, x_2, x_3) = x_1 + (1 - x_1)(1 - x_2)x_3 \qquad (9)$$

All three Lefebvre variables (x_1, x_2, x_3) in Eq. (9) are also given a probability interpretation with values of zero (by convention) being associated with favoring the choice of the negative pole and values of one being associated with the choice of the positive pole. Intermediate values may reflect a lack of information (such as not knowing whether the red dye in the cherry topping is the one to which the customer is allergic or not). Lefebvre also defines a choice function that he calls the "realist choice" that is a function only of the world pressures.

$$f_r(x_1, x_2) = x_1 / (x_1 + x_2 - x_1 x_2) \qquad (10)$$

This function results from the conscious elimination of x_3 by replacing both x_3 and $f(x_1, x_2, x_3)$ by $f_r(x_1, x_2)$ in Eq. (9). Note that f_r has an indeterminate form (can take any value between 0 and 1) in the vicinity of the negative pole $(x_1 = x_2 = 0)$. Lefebvre associates this singular point with a chaotic decision. Also note that for a situation where the world pressure variables are neutral $(x_1 = x_2 = 1/2)$, the value of the realist choice decision probability to choose the positive pole is $2/3$. This 16% bias towards choosing the positive pole is a residual consequence of polarity assignment by human decision agents. This realist choice function is the closest that a reflexive decision agent can come to basing a decision only upon utility considerations.

In another paper that the author (and a co-worker) presented at the Workshop on Multi-Reflexive Models of Agent Behavior, in Los Alamos, New Mexico, in 1998[6], a multi-attribute situation specific decision function methodology was introduced. This function depended upon a set of n situation attribute variables $(y_1, y_2, ..., y_n)$ as well as the Lefebvre preference variable (x_3) and is obtained by the same "clear states/clear choices" elicitation methodology that leads to Lefebvre's general decision model, except that the agent's individual situation logic now replaces Lefebvre's psychologically derived decision logic axioms. The resulting situation specific decision function has the form:

$$g(y_1, y_2, ..., y_n, x_3) = p_1{}^n(y_1, y_2, ..., y_n) + p_2{}^n(y_1, y_2, ..., y_n)x_3, \qquad (11)$$

where $p_1{}^n$ and $p_2{}^n$ are n-linear polynomials of the situation variables. A situation specific realist choice function that depends only on the situation variables may be defined in exact analogy to the general Lefebvre realist choice function yielding:

$$g_r(y_1, y_2, ..., y_n) = p_1{}^n(y_1, y_2, ..., y_n) / (1 - p_2{}^n(y_1, y_2, ..., y_n)) \qquad (12)$$

We argue that this function may be associated with a reflexively derived MAUF where the variables are situation attribute variables instead of object attribute variables. The MAUF thereby obtained has the form of a quotient of two polynomial forms. Zeros of the denominator are guaranteed to occur for at least one point (and usually more) in the situation space. The limit of this MAUF function at these indeterminate points is not well defined. This mathematical singularity of the MAUF (which is independent of any psychological characteristics of the decision agent) will be called an essential singularity. It results directly from the reflexive elicitation procedure that first employs the individual preference variable and then eliminates it through the realist choice. Later in this presentation we will discuss the form that experimental evidence for these essential singularities might take. They basically imply that there are situations where the utilities cannot be defined because the situation variables take conflicting values that leave the decision agent in a state of indecision. Decisions in this situation are time delayed and are random (chaotic) when finally made. While the existence of such states does not seem illogical from the perspective of human psychology (the parable of Buridan's ass who starved to death because he was equidistant between two equally enticing sources of food and could not choose between them)[7], they do present problems for the mathematical structure of the standard utility theory, which assumes that a binary ordering of preferences can always be defined. At the very least, these four axioms about preference ordering must be amended by prefixing the words "except for cases of essential singularity" in order to accommodate the reflexive MAUF procedure. We will not delve more deeply into the formal mathematical implications of these singularities in this work.

In Ref. 6 an association was made between the situation specific decision function and the general decision function (either Lefebvre's or one of the variations considered in Ref. 5) that has the form:

$$f^{xyz}(x_1, x_2, x_3) = f_1(x_1, x_2) + f_2(x_1, x_2) x_3 \qquad (13)$$

The presence of the x_3 variable in each of these (equivalent) human decision representations allows us to derive the following set of coupled (generally nonlinear) equations:

$$f_1(x_1, x_2) = p_1{}^n(y_1, y_2, ..., y_n)$$
$$f_2(x_1, x_2) = p_2{}^n(y_1, y_2, ..., y_n) \qquad (14)$$

which may be inverted to yield functional forms for the Lefebvre variables $x_1(y_1, y_2, ..., y_n)$ and $x_2(y_1, y_2, ..., y_n)$ in terms of the situation variables. These functional forms were called pattern functions in Ref. 6. The thinking behind this terminology is that they represent patterns of subconscious information (feelings) and conscious information (thoughts), respectively, that enable the decision agent to classify the new situation (relying on comparisons with previous experientially derived patterns that are stored in his conscious and subconscious memory). We will also argue that the reflexive MAUF possess essential singularities that are of psychological rather than mathematical origin. These result from values of the pattern functions ($x_1(y_1, y_2, ..., y_n)$ and $x_2(y_1, y_2, ..., y_n)$) that fall outside the acceptable range [0,1]. Such situations present the decision agent with patterns of information that do not correspond to any previously experienced and present problems of classification that complicate the agent's decision process.

Example: The bank patron's windfall

To illustrate these concepts we now present an example. Consider a bank patron who goes to the bank to withdraw a sum of money from his account and discovers after leaving the bank that he has received $450 more than expected by virtue of the fact that five bills that should have been $10 bills were actually $100 bills. The decision facing our agent is whether or not to return the money that was erroneously given out. Let's assume that the patron is basically honest and, hence, would associate a decision to return the extra money with the positive pole and a decision to keep the money with the negative pole. Assume further that at the time of the error's discovery the patron was out of sight of any bank personnel (hence his choice is not influenced by any possible observation of his discovery related behavior by bank personnel).

Now let's consider the special circumstances that influence his decision whether or not to return the money. We introduce a variable y_i that signifies the likely impact upon banking personnel of the error. For example, for $y_i = 0$ we assume that no adverse actions are likely to be taken against any bank personnel for the error (as might be the case if the withdrawal was from an ATM machine). For $y_i = 1$, on the other hand, a specific individual will be held responsible (perhaps a friendly teller whom the patron has known for years) and will be required to make up for the shortfall if the missing money cannot be recovered. Another variable (y_n) signifies the need of the patron for money. Let $y_n = 0$ represent a case where the patron is deeply in debt, perhaps has hungry children at home to feed and cloth, is behind on his rent payment, etc., and has a great need for the extra money. For $y_n = 1$, on the other hand, the patron is economically well-off and has no pressing immediate need for the money. Let y_a represent the patron's general attitude toward this bank.

For $y_a = 0$, the patron dislikes this bank and believes that it routinely takes advantage of poor people. For $y_a = 1$, on the other hand, the patron views this bank as a good institution made up of honest individuals who are interested in helping people. A final variable (y_s) signifies the general societal attitude toward such situations. For $y_s = 0$, the attitude of society can be called a "finders keepers" attitude. Members of this society would not think less of (in fact they might admire or envy) the patron if they were to discover that he had received such a windfall and had taken no steps to give the money back. For $y_s = 1$, however, the attitude of society would look more favorably on an individual who sought to return the money in this circumstance and one who did not would be viewed with general disfavor or scorn.

These four variables capture the external world pressures on the patron to either return the money or keep it. We also introduce the x_3 variable (the preference of the patron to either keep or give back the money that is independent of the world pressures to do one or the other). For example, $x_3 = 0$ might be associated with an individual preference to be greedy and keep the money in order to spend it on some unnecessary personal extravagance, while $x_3 = 1$ might be associated with a preference to give the money back because of the likely praise and gratitude that the patron would receive from the affected bank personnel for this action. The Table shown below represents the "clear states/ clear choices" for our variables and assigns values for the decision function. In populating this table we used a set of decision logic rules that capture the personality dependent factors of this particular agent. These rules may be chosen arbitrarily to suit whatever personality we deem appropriate. For this case we have four world pressure variables that either favor or disfavor returning the money (depending on their values).

We adopted a majority rule that says that, except for the special case to be described, the money will be returned whenever a majority of these world pressure variables favor return and the money will be kept whenever a majority favors keeping it; with ties (two for return and two against return) being broken by letting the decision follow the value of the x_3 (preference) variable. The special case consists of both the y_n and x_3 variables taking the value 0 (both favor keeping the money). We assumed that our agent faces a moral dilemma in this situation because he needs to spend the money for support of his family, but wants to spend it on a personal extravagance. The rule that we adopted in this special case situation is that the money will be returned so that the agent can avoid this moral dilemma. This special case rule (Need Negates Greed) was strictly applied (taking precedence over the majority rule even when all other variables favored keeping the money).

Now we can use the *Mathematica*[tm] software package to derive the 5-linear polynomial function that fits this logic table. The result is:

Table 1: Logic Table for the Bank Patron's Windfall

y_i	y_n	y_a	y_s	x_3	$g(y_i, y_n, y_a, y_s, x_3)$
0	0	0	0	0	1
0	0	0	0	1	0
0	0	0	1	0	1
0	0	0	1	1	0
0	0	1	0	0	1
0	0	1	0	1	0
0	0	1	1	0	1
0	0	1	1	1	1
0	1	0	0	0	0
0	1	0	0	1	0
0	1	0	1	0	0
0	1	1	0	0	0
0	1	0	1	1	1
0	1	1	0	1	1
0	1	1	1	0	1
0	1	1	1	1	1
1	0	0	0	0	1
1	0	0	0	1	0
1	0	0	1	0	1
1	0	0	1	1	1
1	0	1	0	0	1
1	0	1	0	1	1
1	0	1	1	0	1
1	0	1	1	1	1
1	1	0	0	0	0
1	1	0	0	1	1
1	1	0	1	0	1
1	1	1	0	0	1
1	1	0	1	1	1
1	1	1	0	1	1
1	1	1	1	0	1
1	1	1	1	1	1

$$g(y_i, y_n, y_a, y_s, x_3) = 1 - x_3 + x_3 y_a y_i - y_n + x_3 y_n + x_3 y_a y_n + x_3 y_i y_n + y_a y_i y_n -$$
$$- 3 x_3 y_a y_i y_n + x_3 y_a y_s + x_3 y_i y_s - 2 x_3 y_a y_i y_s + x_3 y_n y_s + y_a y_n y_s -$$
$$- 3 x_3 y_a y_n y_s + y_i y_n y_s - 3 x_3 y_i y_n y_s - 2 y_a y_i y_n y_s + 5 x_3 y_a y_i y_n y_s \qquad (15)$$

All further manipulations of this function (both numerical and analytical) are carried out with this software package. The realist choice decision function is easily found to be:

$$g_r(y_i, y_n, y_a, y_s) = (1 - y_n + y_a y_i y_n + y_a y_n y_s + y_i y_n y_s - 2 y_a y_i y_n y_s) / (2 - y_a y_i - y_n -$$
$$- y_a y_n - y_i y_n + 3 y_a y_i y_n - y_a y_s - y_i y_s + 2 y_a y_i y_s - y_n y_s + 3 y_a y_n y_s + 3 y_i y_n y_s - 5 y_a y_i y_n y_s) \qquad (16)$$

By simple inspection it is easy to show that g_r is of indeterminate form $(0/0)$ at the point $(0,1,0,1)$. Other points of indeterminacy exist as well, but our claim can be demonstrated by investigating this one. The graph shown in Fig. 1 below demonstrates that the limit of g_r takes different values as the indeterminate point is approached along two different paths. For the upper curve, we let $\{y_i \to y_a,\ y_n \to y_s,\ y_s \to \exp(-y_a)\}$ while for the lower curve we let $\{y_i \to y_a,\ y_n \to y_s,\ y_s \to \exp(-2y_a)\}$. These are two different paths to the point $(0,1,0,1)$ as $y_a \to 0$.
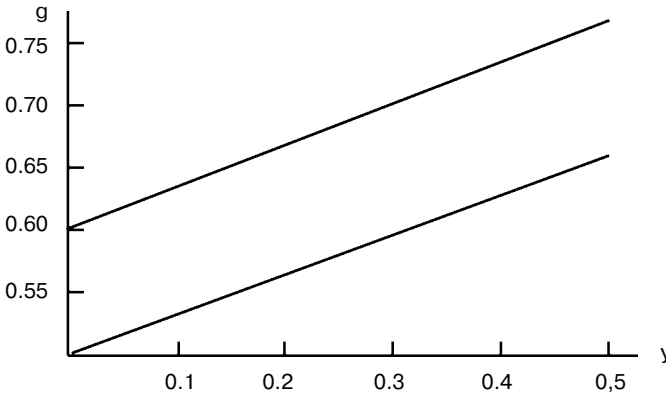
Fig. 1: Limits of the realist choice function along two different paths to the indeterminant point

Now if we assume that our bank patron is a Lefebvre agent (Eq.(9)), the equations to be inverted to derive the pattern functions are:

$$
\begin{aligned}
&x_1 = 1 - y_n + y_a y_i y_n + y_a y_n y_s + y_i y_n y_s - 2 y_a y_i y_n y_s \\
&(1-x_1)(1-x_2) = -1 + y_a y_i + y_n + y_a y_n + y_i y_n - 3 y_a y_i y_n + y_a y_s + y_i y_s - \\
&- 2 y_a y_i y_s + y_n y_s - 3 y_a y_n y_s - 3 y_i y_n y_s + 5 y_a y_i y_n y_s
\end{aligned}
\tag{17}
$$

The result of inverting these equations is:

$$
\begin{aligned}
&x_1(y_i, y_n, y_a, y_s) = 1 - y_n + y_a y_i y_n + y_a y_n y_s + y_i y_n y_s - 2 y_a y_i y_n y_s \\
&x_2(y_i, y_n, y_a, y_s) = (1 - y_a y_i - y_a y_n - y_i y_n + 2 y_a y_i y_n - y_a y_s - y_i y_s + 2 y_a y_i y_s - y_n y_s + \\
&+ 2 y_n y_a y_s + 2 y_i y_n y_s - 3 y_i y_n y_a y_s)/(y_n(1 - y_a y_i - y_a y_s - y_i y_s + 2 y_a y_i y_s))
\end{aligned}
\tag{18}
$$

A simple substitution into Eq. (18) will show that the x_2 pattern function is outside its acceptable range (equal to $5/4$) at the point $(1/2,1/2,1/2,1/2)$. There are, in fact, significant hypersurfaces in the situation space that violate the range $[0,1]$ for x_1 and/or x_2 as can be easily shown by fixing two of the variables and plotting 3D surfaces for x_1 and x_2 in the two remaining variables. These hypersurfaces also represent essential singularities of the reflexive MAUF.

It remains only to define the utility function associated with this choice. There is, of course, a utility equivalent to \$450 in keeping the money (choosing the negative pole). There is no "measurable" utility in returning the money (choosing the positive pole), although the fact that this is a frequently made choice (indeed, one that the author himself once made in a similar circumstance) argues for an unmeasured utility that compensates for the loss of the \$450. We define the "measured" utility to be:

$$g_{util}(y_i, y_n, y_a, y_s) = \$450\,(1 - g_r(y_i, y_n, y_a, y_s)) \tag{19}$$

This is just the monetary value of choosing the negative pole multiplied by the probability of choosing the negative pole. The quotient form of the realist choice function guarantees that this reflexive MAUF possesses the singularities that are the principle concern of this work.

The unmeasured utilities referred to in the last paragraph may be inferred by examination of the situation variables themselves. For example, $y_i = 0$ inclines the bank patron to keep the money, an option that has clear economic utility, but one which may still be accompanied by pangs of conscience. As $y_i > 1$ the economic utility diminishes (since the chance of keeping the money becomes less). The pangs of conscience are also diminished under this circumstance. The variable y_i, itself, might be associated with a single attribute utility function (the utility of possessing a clear conscience). Likewise, y_n might be associated with the utility of not being needy, y_a might be associated with the utility of not holding malice, and y_s might be associated with the utility of living in a society that values honesty.

When these variables are viewed as single attribute utility functions, the polynomials p_1 and p_2 (Eq. (14)) are seen to have the Keeney/Raiffa linear additive form. This suggests that an appropriate functional form for the MAUF of our earlier example might be:

$$U_{MAUF}(S,D,T) = \frac{aU_{CD}(S.D) + bU_{CT}(S,T) + cU_{CD}(S,D)U_{CT}(S,T)}{(1 + dU_{XD}(S,D) + eU_{CT}(S,T) + fU_{CD}(S,D)U_{CT}(S,T))} \tag{20}$$

This would mean that our entrepreneur would have to conduct six independent lottery experiments (twice the previous number) in order to completely specify his MAUF; however, this would certainly be worth the extra effort if it were successful at removing the lack of uniqueness of MAUF determination. This procedure permits (although it does not guarantee due to the discrete nature of the variables) an essential singularity structure of MAUF based on object attributes that is analogous to the reflexive MAUF of situation attributes. The only way to show whether this improves the MAUF situation is through experimentation.

Experimental evidence for essential singularities of MAUF

Recently reported psychological experiments[8] could be interpreted as evidence for essential singularities of MAUF. Implicit association tests may be best understood in terms of a thought experiment. Suppose a respondent is sequentially shown a series of human faces and asked to raise his right hand (as quickly as possible) when shown a female face and his left hand when shown a male face. Next, the same respondent is sequentially shown a series of first names (easily recognizable as belonging to males or females) and again asked to quickly raise his right hand when shown female names and his left hand when shown male names. Now these two tasks are combined with the respondent not knowing whether the next stimulus will be a face or a name and the time required to complete the exercise is recorded. Finally, the combined task is repeated, except that this time the respondent is asked to raise his left hand when shown a female name and his right hand when shown a male name. The time required to complete the task is again recorded. Because of the requirement to change the signaling mechanism (left or right hand) signifying male or female depending on whether the stimulus is a face or a name, this last exercise should take longer to complete than the previous for most respondents. The time differential between these two tasks would be a measurement of the gender related implicit associations of the respondent between human faces and names.

The real experiments of Ref. 8 involved the measurement of implicit associations between names recognizable as being associated with specific ethnic groups and English words with either pleasant or unpleasant connotations. One experiment involved two groups of subjects (Japanese American and Korean American students at the University of Washington) who were shown the stimuli (ethnic surnames of Japanese or Korean origin or pleasant or unpleasant words) on a computer screen and asked to register their responses by pressing either the keyboard A with the left hand index finger or the number pad 5 with the right hand index finger. The response times were recorded and statistically analyzed. A similar experiment was conducted involving first names recognizable as being associated with European American or African American ethnic cultures. Although most respondents in these experiments professed not to hold feelings and thoughts indicative of racial and ethnic prejudice, the statistical evidence showed strong implicit association between the names associated with the respondent's own ethnic group and words with a pleasant connotation and between the names of the opposite ethnic group and the words with unpleasant connotations. The authors of Ref. 8 interpreted this as evidence of subconscious (or consciously suppressed) prejudice.

Rather than being evidence of racial and/or ethnic prejudice, this would seem to be, instead, evidence of the self-referential nature of all decisions (however trivial), evidence of expected polarity assignment between like self and unlike self imagery (us or them), and also evidence of classification delays associated with the essential singularities of reflexive MAUF.

These implicit associations (associating specific ethnic groups with either pleasant or unpleasant subjects) depending on one's own ethnic identity are not so much a measure of real associations in the minds of the respondents as they are a measure of the ease with which the respondents can accept such an association. This is an important distinction. It is the difference between accusing someone of the commission of a crime and accepting that a third party accusation is believable. What matters in such situations is not our initial response to the third party accusation (momentary belief or disbelief) but the ethical manner with which we weigh the actual evidence in forming our opinion of their guilt or innocence. The classification delays associated with momentary disbelief as we weigh what appear to be conflicting attributes are precisely what we would expect from the essential singularities that are the subject of this paper.

Conclusions

One might well ask "Why complicate the already complex MAUF procedure by introducing the reflexive elicitation approach with its associated essential singularity structure?" This is an especially important question given the noted challenge that this reflexive MAUF approach poses for the formal mathematical axioms of MAU theory. Our view is that the conventional MAUF elicitation procedure already suffers from the existence of these essential singularities, which may be responsible for some of the inconsistencies noted in the introduction. By acknowledging the existence of essential singularities and building an elicitation procedure that is capable of capturing them, we hope to return some of the utility to multi-attribute utility theory.

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CHRONICLE OF EVENTS

International symposium "Philosophy and cognitive sciences" (Paris, June 19-22, 2002)

The annual session of the International Academy of Philosophy of Science (Academie Internationale de Philosophie des Sciences) and the international symposium of the members of that Academy devoted to discussion of the issues of interrelation between philosophy and cognitive sciences was held at Sorbonne in Paris.

Such well-known representatives of science as M.Bunge, K.Gempel, A.Grunbaum, N.Rescher, G.Holton were members of that Academy.

About 50 scientists from Austria, Belgium, Spain, Italy, Peru, France, USA, Russia and Switzerland discussed various issues related to the whole complex of cognitive sciences. Thus, President of the Academy Agazzi (Italy) dwelled on the nature of interaction between cognitive sciences and philosophical anthropology, Descleaux (France) spoke about the diversity of languages, "the invariants" of the process of cognition and the specifics of the architecture of computer technology, Miro Quesada (Peru) analyzed the general and the different in the intuition of scientist and the inspiration of poet Curalto (Spain) and presented a computer model of the human intelligence.

Russia was represented by Bazhanov, who presented his report "Reflexion and Development of the Me-Concept". The report urepresents reflexion as an epistemological and psychological phenomenon as an analogy between the laws of functioning and complication of the reflexion in the process of cognition and the formation of self-consciousness of an individual. What are the historical preconditions of the reflexion and self-reflexion? How are the developments of consciousness, self-consciousness and perceptions of oneself related to each other? What are the laws of formation of the personalized form of reflexion in the context of social psychology? Is it possible to find traces of that process in culture, art and science? Are any analogies between the evolution of self-consciousness of science and human self-consciousness admissible? All those questions were touched upon in Bazhanov's report.

As presented by some active Academy members, Bazhanov and Stengers (Belgium) were nomunated to the Academy corresponding members. The vote resulted in Bazhanov's election.

The next session of the Academy will be held in 2003 in Italy and it will be devoted to the axiological problems of science.

L.I.Kopylova
Candidate of Science (Philosophy), Docent

NEW BOOKS

Information. Diplomacy. Psychology.
Editors-in-Chief Yu.B.Kashlev, V.E.Lepsky, E.A.Galumov − Moscow.: "Mysl" Publishing House, 2002. − 616 pp.

There are enough grounds to assert that diplomacy as a science and a practice is rather a beneficial field for both a study reflexive processes an application of the results of that study to the practical activity. Put yourself in the other's place; ponder on the pattern of his/her thoughts and try "to reconstruct" for, desirably, good purposes, but sometimes to ensure the task of self-survival; may you know that your partner also guesses your intentions and aspires to reconstruct you – all of those are the reflexive processes and reflexive control. And all of those reciprocal flows of knowledge are permeated with passions, the inevitability of decision-making under the conditions of incomplete certainty, while simultaneously, they are vested with the burden of cultural-religious traditions and ethnic stereotypes. Reflexivity in those conditions is in a highest demand, and the diplomats, indeed, have always "spoken in prose", if we were to recall Moliere's M.Jurdin, without guessing at all about that, i.e., have used reflexive approaches without being aware about the theories of reflexivity.

The situation has changed: the diplomacy sends requests to reflexologists, while those in their turn recognize the relevant subject field as a very important space for testing their research results. The book analyzed testifies to that.

In many respects it is of a break-through nature and is not so much a collection of materials of "a round table" and lectures of the lecturers of the Diplomatic Academy of the Ministry of Foreign Affairs of Russia, as it is indicated in the annotation with diplomatic modesty, but rather a collective monograph the theme of which is to teach diplomats and provide for their decision-making in their practical work according to the standards of the contemporary science. It is in that capacity that it is perceived by the readers, not only those involved in diplomacy, but also all of those interested in what information society is and how to live in it. In these terms the book is not just a collective monograph, but also an effective learning manual which includes rich documentary and reference base.

The book consists of 5 sections: "Information society. The state's image. Information wars", "Information and diplomacy. Information security", "Terrorism and information", "Mass media in Russia and the CIS", "Professionalism in the information work". The tone of discussion of the topics specified in those is set by Doctor of Science (History, Head of the Chair of Mass Communications and Public Relations of the Diplomatic Academy of the MFA of Russia Professor Kashlev. He especially emphasizes the substantial nature of the potentials introduced by the theory of reflexive processes, which became the point of issue at "the round table" on November 30, 2001 organized by the Chair of the Laboratory of Psychology of Reflexive Processes at the Institute of Psychology, Russian Academy of Sciences.

The greatest attention at the session was attracted to the speech of its Head – Doctor of Science (Psychology) Lepsky, on the basis of which an article was written on the fruitfulness and even the inevitability of relying on the humanistic paradigm in the pursuit of foreign (and domestic as well) policies of Russia in the 21st century. Whatever have been the names of the predecessor paradigms – natural scientific, technocratic etc. – one thing is clear: relying on those is already not possible not just to preempt, but just simply to tackle with the constant and "unexpected" threats of global nature. The idea is justified that the reflexive approach relying on the methods of objective description of systems together with their subjective internal worlds is the basis of harmonization of subjects (p.84).

Doctor of Sciences (Psychology), Professor of the Russian Academy of Civil Service Anisimov raised the problem of increasing reflexive culture in the international coordinating processes. Such culture is a precondition of efficiency of processes of self-organizing in various kinds of professional activities, first of all those connected to negotiation practice. One of its tasks is to create information and estimation criteria excluding destructive accidents in the negotiation process. Reflexion, therefore, should necessarily include a moment of return to the stable preconflict past-

and simultaneously project the non-conflict future. Only then the coordinating processes will become a reliable means of solving the conflict situations at present.

Galumov (Candidate of Science in Economics) emphasized in that connection the importance of a new and positive image of Russia in the global economic space, which requires some reflexive "clean-up" of the communication channels and adaptation information technologies. The task is set to create a synthetic model of Russia's image, taking into account the dynamics of transformation processes inside the country and its relations with the other countries.
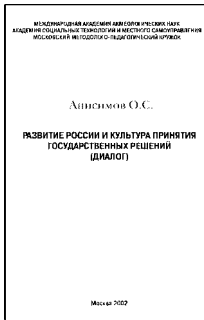
Rastorguyev (Doctor of Science in Technology) revealed the destructive aspects of the use of reflexibility in the terrorist operations, the purpose of which is to undermine the information life-support of the largest social structures. The appropriate operations, he points out, are designed with "a calculation of the future obviously further than just one next step of the opponent" (p. 405). Then the counterterrorist actions as well should be designed further than that one next step, which is possible only with reliance on the humanitarian paradigm of foreign and domestic policies.

Matveyeva (Doctor of Science in Psychology) pointed out an Important, and in many respects key role of reflexivity in the analysis of psychological aspects of media communications. Of especial significance is the role of a certain reflexivity armor in terms of ensuring the self-identity of an individual, an ethnic group or a society under the conditions of multiplication of information flows and amplification of their intensity.

Experts of the Scientific Research Institute of Information of the MFA materialized the ideas of reflexive approach in their subjective-activity interpretation (V.Ye.Lepsky, 1998) in "Diplomat" information-analytical program complex. Its main task is to support decision-making processes in various spheres. Diplomats have already begun using it and thus raising the culture of reflexivity in decision-making.

E.G.Lavrik

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Anisimov O.S. Development of Russia and the Professionalism in the Decision-Making. — Moscow, 2002. — 140 pp.

МЕЖДУНАРОДНАЯ АКАДЕМИЯ АКМЕОЛОГИЧЕСКИХ НАУК
АКАДЕМИЯ СОЦИАЛЬНЫХ ТЕХНОЛОГИЙ И МЕСТНОГО САМОУПРАВЛЕНИЯ
МОСКОВСКИЙ МЕТОДОЛОГО-ПЕДАГОГИЧЕСКИЙ КРУЖОК

Анисимов О.С.

РАЗВИТИЕ РОССИИ И КУЛЬТУРА ПРИНЯТИЯ
ГОСУДАРСТВЕННЫХ РЕШЕНИЙ
(ДИАЛОГ)

Москва 2002

This book is a unique example of a popular description of complex problems of professionalism in the state decision-making. In its essence it lies the substantiation of the strategic idea that is a response to the appeal to find nontraditional resources for Russia's fast growth, its "breakthrough". The book explains the dependence of the quality of control decisions on fulfillment of the requirements of the proffesionalism of thought and reflexion.

In an interesting display of interaction between the typical protagonists, among which, besides the President, there are his Assistant on national security, a Conceptologist on the problems of security, a Regional manager, a Representative of scientific community, the Head of the educational system, a Representative of public organizations and a Methodologist, arguments characteristic to a discussion and its orientation on the contents of thought are presented. Thanks to the Methodologist's skilful influence, a substantiation is given to the principle assertion about a possibility of not only sharply increasing the quality of thinking and its results, but also of ensuring the reliability of the whole system of the country life. Thus, a convincing demonstration is given of an actually unnoticed resource for the development of the country as a whole by means of using a professionally higher-level administrative thinking.

The originality of the book's material, which is expressed in the form of a dialogue, a correlation and opposition of different points of view, is that the final idea, the project proposals are not provided as the ready recipes, but step from a multilateral approbation and accumulation of the

importance of the initially "ordinary thoughts." The author gives a vast open space to doubts and disagreement between the points of view. A soft introduction of the answer to the question initially put by the President about the reserves for a possible Russia's "breakthrough" into the general quest and a seemingly imperceptible approach to the strategically important thought are important.

The project proposals expressed at the end of the dialogue and arranged in a strict form of "a summary" rely not only on their systematic preparation, but, first of all, on the practice of organization of the administrative decision-making processes that have taken shape in Russia, with the latter having its own peculiarities in comparison to the world practice.

Since the 1970s a general form of collective search for new improved decisions has been developed within it, the basis of which consists of game-modeling with methods and means of organization of thinking and reflexion applied. It has been within the framework of such game-modeling that a steady influence of the culture of thinking on the quality of decision-making has been demonstrated. In fact, within such modeling, a technology of reflexive control has been elaborated, the quality of which has no precedents in the world administrative practice. Therefore, the dialogue is not of only culturally acquainted and project oriented importance, but also is characterized by responsibility for the realistic nature of the project proposal system.

In addition to the main dialogue, the book also offers a dialogue on "Administrative decision-making", which is given as an appendix. That dialogue reveals the mechanism of culturally important decision-making process including both the main process in a decision-maker's position and the two types of service – technological and conceptual. The appendix demonstrates that the conceptual – technological support to the thinking reflects a transition from the existing form of decision-making in its best domestic and foreign versions to their type, within which unknown opportunities to increase the quality of the decisions and the organization of their making are realized. Both dialogues are needed to provide arguments in favor of the main proposals and perspective approaches, but the dialogue given in the appendix is more complex and is intended for professionals, rather than "a customer" of project proposals.

I.E.Zadorozhnyuk

ANNOUNCEMENT

A book "Algebra of Conscience" by *V.A.Lefebvre*
Kluwer Axademic Publishers, 2001
<services@wkap.nl>

TO AUTHORS

All materials must be sent only in electronic format by e-mail or on a diskette. Size of an article is up to 12 pages (Microsoft Word, Times New Roman font, 12 pt, 1.0 or 1.5 sp, with figures as the separate files). The literature is to be at the end of the article with the digital references to it within the text.

A brief information about the author, the author's photo (TIFF format file), his/her address, telephone, fax and electronic mail address (e-mail is obligatory) are to be also attached to the article.

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