

The influence of semantic disinformation at fast decision-making in the uncertain situation

Emelyanov A.S.
Kursk State University
Kursk, Russia
andrei.e1992@mail.ru

Abstract — The process of fast decision-making in the uncertainty situation in scientific literature after works by D. Kanemann, A. Tversky and R. Thaler is traditionally described by illogicality and lack of use of rational decision-making mechanisms. But today an issue of the impact of a logical form of language (disinformation, logical probability and logical contradiction) on decision-making has not been studied yet. In this study the interrelation between the size of semantic disinformation of language and acceptance of fast and slow decisions becomes apparent. To that end, two experiments were carried out. In the first experiment there analyzed the influence of size of semantic disinformation at fast decision-making. In the second experiment there analyzed the influence of semantic disinformation at slow decision-making. Additionally correlation analysis of characteristics of age, logical competence, time of decision-making and size of semantic disinformation is carried out. In the study we have established: 1) inefficiency of level of logical competence and mechanisms of classical rationality at fast decision-making; 2) positive correlation of time of the decision and level of logical competence of subjects in the process of slow decision-making.

Keywords — fast decision-making, slow decision-making, size of semantic disinformation, logical competence, subjective assessment of logical competence.

I. INTRODUCTION

The modern global situation could be described by increase of informative content of communication, high speed of its transfer and limitation of time for its subjective assessment.

The global information policy sets a behavioral metrics which activates mechanisms of fast thinking and decision-making. In such a situation the quality of the information obtained, its completeness and timeliness must also be to the fore. Currently the large number of strategy of human behavior in situations of different degrees of uncertainty is offered. The behavioral mechanism of decision-making in such situations has been described in some works of American researchers D. Kahneman, and A. Tversky, (2000), R. Thaler, A. Tversky, D. Kahneman, and A. Schwartz, 1997). In particular *the system of quick thinking - decision-making* of D. Kanemann (*System 1*) differs with the greatest degree of uncertainty. In these studies the superiority is traditionally given to an intuition and probabilistic forecasting. In most of the works it has been also shown that strategies are popular in an uncertain situation in adopting of the most effective decisions. These strategies combine rational analysis and an intuition, also cognitive and emotional mechanisms. This largely reflects that in psychology of decision-making the position asserted in the last decade. According to which a situation of decision-making is considered as "a cognitive task" by T. Kugler, A. Rapoport, and A. Pazy (2010) which we have to decide. In the analysis of

the factors influencing the origin of framing effect allocate several approaches.

In a number of studies, in particular in recent work by W. Eberhardt, W. B. de Bruin, and J. Stroogh (2018) it is specified that the age factor has a positive decision, minimizing influence of framing effect.

According to results, W. Eberhardt, W. B. de Bruin, & J. Stroogh conclude that people of more advanced age differ in more effective financial decisions. Also this category of people is a less subject to different cognitive distortions and framing effect in particular. In another study by C.E. Löckenhoff (2011) the thesis according to which cognitive distortions and framing effect are directly connected with the level of development of rational mechanisms of thinking of the person have been put forward. According to this the results have been put forward confirming negative impact framing effect on children and elderly. Children had negative effect because of insufficiently developed structure of rational thinking. Elderly people, in contrast, had it because of its deterioration. In the similar vector there develop the research by S. Watanade, H. Shibutani (2010).

A. K. Thomas and P.R. Millar (2012) as well as B. Keysar, L. Hayakawa Sayuri and An. S.G., (2012) develop another factor. These researchers come to a conclusion that the special emotional and substantial characteristic of language within which cognitive thinking is carried out exerts impact on framing effect. At that minimization of effect is observed at the appeal to foreign languages. The subjects who were offered to make a choice in nonnative language, as a rule, with great attention treat the logical form and probabilistic estimates allowing to avoid in most cases cognitive distortion. In the researches of T.V. Kornilov, Krasnov and others there develop the intellectual and personal approach of consideration of a situation of decision-making. Special attention in this approach is given to a regulatory role of intelligence in decision-making and also its interrelation with different level structures in the personal sphere of a person. According to the researchers, for decision-making success *forecasting* or a number of the processes realizing predictive activity of the person is a necessary process. This approach relies on tools different kinds of game tasks (Iowa test, properties of the Dark triad and the Big five). The originality of such approach is that results of researches call into question a number of the established theoretically-methodological concepts, in particular, of understanding framing effect as purely cognitive phenomenon, regulation of strategy of elections in the conditions of uncertainty at the level of visceral components of feedback and also interrelations of scales of intelligence and motivation (M.S. Zirenko , Yu.V. Krasavtseva, S.G. Kerimova etc.). However the majority of researches in this direction have purely *analytical* character, and an integrated approach

difficult to achieve which would allow to capture all possible aspects of regulation of strategy of elections within the psychological experiment. The usage of intellectual and personal approach is limited to situations when as conditions of decision-making only uncertainty is considered. The situations where time factor is added as a condition aren't considered within this approach and in general are difficult for interpreting. In particular it concerns the System 1 of D. Kahneman and over risky situations of fast decision-making. Other vector of researches is developed in works of psychology of an insight (V.G. Spiridonov, G. Knoblich, S. Ohlsson and G.E. Raney). In insight psychology the problem of forecasting as the central element in very fast situations of decision-making in an uncertainty situation contacts the cognitive Aha- phenomena mechanism. It should be noted that within this approach the problem of decision-making and respectively to overall effectiveness of adoption of successful decisions doesn't take the central place. It concentrates the attention on consideration of cognitive mechanisms of the solution of tasks in such situations where examinees are characterized by low awareness on proximity of finding the answer (an uncertain situation). Within such approach the questions of a so-called "facilitation of influence" of emotions on cognitive process of the decision have been raised. It should be noted that integration of the emotional sphere with a situation of decision-making is associated with A. Damasio who has made a hypothesis of "somatic markers" (Damasio, 1996). Markers at the same time are understood as the visceral reactions arising at certain symptoms constructed on the basis of the previous individual experience and which are subjectively endured as "suspicions". In many respects the fact that it serves as theoretical support of identification of mechanisms of violation of feedback for various clinical groups on the basis of uniform heuristic model promoted public awareness of this concept. In researches of O.V. Filyeva, I. Y. Vladimirov, V.A. Kramer, S.Y. Korovkin etc. some attempts had been made to use emotional assessment as the indicator of proximity to the answer at the solution of insight tasks. The results have shown that the emotional report isn't connected with proximity of finding the decision; insight tasks provoked sharp negative affect shortly before finding the decision that demonstrates "invisibility" of progress in the solution of insight tasks not only for cognitive components of mentality but as well for affective ones. The specified works critically consider the emotional sphere as the mechanism of regulation of a profile of anticipation which is the central element in intellectual personal approach.

II. BACKGROUND

In the most of researches the methodology and diagnostics boil down to individual and personal assessment of a condition of subjects in the analysis of decision-making in an uncertain situation. The situation of uncertainty admits how adequate for the casual observer, and the mechanism of decision-making lies in the depth of a psychological and heuristic human condition. Essentially, the information environment in which it is placed a person who deciding a priori is recognized as the full and consistent. These experiments, in our view, significantly influence its accuracy and adequate interpretation. It should be noted that researches devoted to influence of the information environment on the choice of the subjects (information framing) are not great. Only in some of them (B. Grosskopt, I. Erev and E. Yechiam (2006) and H. Noijtink

(2012) we consider concepts of information completeness about subject to the choice. In researches by R. Thaler, A. Tversky, D. Kahneman and Schwartz (1997) this topic contacts the nature of mistakes at decision-making to the inherent system of fast decision-making. It is noted that the limitation of time of decision-making (fast decision-making) rather often leads to mistakes and also to the choice of options, contradictory and least probable on the offensive options. At the same time, the quality and semantic contents of information aren't considered as the main predictors. Influence of the information environment on decision-making is considered from the point of view of "individual distinctions" (E. Yechiam, J.C. Stout, J.R. Busemeyer, S.L. Rock and P.R. Finn (2005) and it also doesn't represent complete methodology of assessment of semantic nature of information content of a situation of the choice.

In our research we tried to consider influence of information content of a situation on decision-making by submitting disinformation as one of the basic elements of a situation of uncertainty. According to C. E. Shannon's definition (1948) we will understand information as what reduces entropy of some system. Then under disinformation, we will understand a complex of means, receptions and contents which increase the size of entropy of system. It should be noted that in this case the importance of psychological non-cognitive aspects of decision-making is indisputable. Namely: rhetoric, oratory, personal charisma, emotions, neurolinguistics programming and many other things. However anywhere the attempt of consideration of the logical party of "effect" still hasn't been made. This research seeks to level this shortcoming and to analyze influence of quantity of semantic disinformation of the message and a logical form of the message on decision-making in an uncertainty situation, having addressed the theory of semantic information (its classical and modern option).

As a basis of the analysis of semantic contents of an utterance, we were based on modified and refined theoretical base of the classical theory of semantic information of R. Carnap and I. Bar-Hillel (1953) or "Theory of Weakly Semantic Information", "Theory of Strong Semantic Information" by L. Floridi (2004, 2005, 2009) and also hypothesis of interrelation of semantic information and disinformation by O.A. Pogorelov (2013).

In some works, beginning from classical ones (D. Kahneman 2003), where fast decisions admit for illogical and irrational and ending with (Evans, J. St. B. T. (2004, 2005), R. F. West and K. E. Stanovich, 2003), where to fast and traditional types of decision-making there correspond rational and irrational processes of thinking, – the status of classical rational interpretations was estimated differently. Within this research, as the rational mechanism of decision-making its logicity is accepted. It is dictated with: 1) traditional recognition behind a rational form of thinking of its logicity; 2) a subject of research, disinformation which connect semantics of language of logic of an utterance.

So, for example, in the well-known work of D. Kahneman and A. Tversky (2003) there considered a framing effect which is connected with the well-known task about "An Asian disease". As confirmation framing effect researchers address different versions of its contents, adapting and transforming it depending on problems of an experiment. The second example, as envisioned by D. Kahneman and A. Tversky which demonstrates his existence can be subjected to the analysis of logical-semantic contents of information which is beared by the options which are its parts. It is interesting that when

comparing size of semantic disinformation in the first (0,25) and in the second example (0,375), insignificant increase in the last in the second example is observed. For other examples we observe a similar picture. Proceeding from it, it is surprising how the human brain instantly reacts even to minor changing of semantic contents (increase/reduction of size of semantic information) and every time gives preference to disinformation!

III. AIMS AND OBJECTIVES

Despite the considerable volume of researches in the field of the theory of the decision-making (DM), factors of influence on the strategy of behavior at adoption of fast decisions in an uncertainty situation still remain unstudied. In particular, the special attention is deserved by studying a question of influence of the information environment and degree of awareness at choice. One of distinctive characteristics of a situation of uncertainty, in our view, with time factor (namely its shortcoming) is the size of semantic disinformation. A large number of works focus the attention on individual and personal features of the mechanism of decision-making, leaving aside collective ones.

Considering a role of such factors as decision-making time (the solution of a cognitive task), size of semantic disinformation about a choice subject, the rationality level (subjective and objective assessment of logical competence), we have assumed that on adoption of fast decisions the size of informational content (disinformation) makes direct impact. At the same time, we considered the possibility of interpretation of the choice of subjects on the basis of classical rationality meaning first of all existence of logicity and lack of contradictions in thinking.

A number of concrete hypotheses has been checked:

1. The size of semantic disinformation exerts impact on adoption of fast decisions in an uncertainty situation.
2. Level of rationality of thinking of subjects isn't correlated with the choice at fast acceptance of the decision in an uncertain situation.
3. Level of rationality of thinking of subjects is correlated with the choice at slow acceptance of the decision in an uncertain situation.

IV. EXPERIMENT 1

During the experiment we investigated the influence of disinformation size of an utterance on adoption of fast decisions.

The next mental experiment has been offered to subjects. "Imagine that you command some group of troops (group A, group B, group C). You are told several reports and options (forecasts of development of the situation). Estimate plausibility of each of the report at extremely short time ($t \leq 1 \text{ min}$)". The form with reports has been provided to each of subjects. Results of participants of poll which didn't satisfy experimental conditions were rejected. The order of reports in groups changed to level influence of priming on the choice of subjects.

So, the following reports were offered to subjects:

H_1 : If the groups A or B move forward in squares N and M, then either the group C will have to move forward in a square O, or there will be a serious threat on this sector of the front.

H_2 : Only if the groups A, B and C move forward in the corresponding squares n, m and o, there can be a dangerous situation on this sector of the front.

H_3 : The situation on this sector of the front may be dangerous or not, it will completely depend on that: if the groups A and B in the outlined squares will move forward (n and m), and the group C will continue to take the positions.

V. EXPERIMENT 2

Influence of size of disinformation of an utterance on adoption of slow decisions (strategy) was investigated. During the research the similar mental experiment with excellent, but close statements has been offered to subjects. Time for work has been increased till 1 o'clock ($t \leq 60 \text{ min}$).

H_4 : If the groups A, B and C move forward to conditional squares (N, M and O) then the threat for the front will be created.

H_5 : If the group A moves forward into N square, then the group B will move forward in a square M. If the group B moves forward in a square M, then the group C will move forward in O. Consequently, this relocation doesn't create a dangerous situation for the front.

H_6 : Only if the groups A and B don't move forward in squares N and M then the group C which has moved forward in a square O, will eliminate threat on this sector of the front.

VI. MATERIAL AND METHODS

Participants of the research. 119 same-gender subjects (M) which have been divided into five groups have participated in the research. The number of people in Groups № 1-4 22, in Group №5 21. Averages on the number of subjects in the M=22 groups; SD = 0,32. Averages on age of M=18; SD = 0,44.

Static methods (parametrical methods). The achieved level of meaning (p) was calculated in all procedures of the statistical analysis at the same time the critical significance value in this research was accepted equally 0,05. For check of statistical hypotheses of distinctions of absolute and relative frequencies, medians and interrelation of predictors in five independent selections the rank t-criterion of Kruskal-Wallis was used. The confidential intervals (CI) in this work were under construction for confidential probability $p=95 \%$. For definition of existence of functional communications between predictors calculated coefficient of correlation p of Spearman.

Dependent variables: indicators "Choice" (1), "Choice" (2).

Methodology of assessment of size of semantic disinformation of an utterance. Utterances ($H_1, H_2, H_3, H_4, H_5, H_6$) – were translated into symbolical language of logic of utterance. To each formula of a statement the table of the validity of the variables which are its part was under construction. Proceeding from these tables, there was a logical probability of each formula which corresponded to semantic information of the formula of an utterance specified on an interval [0; 1].

Under *semantic information*, i.e. the content of the utterance H_n will be understood as the set $M_H(A) / M_H$, where M_H is the range of possibilities H, and $M_H(A)$ is the range of values 1 of M_H . This definition is consistent with the semantic theory of information Carnap-Bel-Hillel. According to the proposal of Pogorelsky, we will also consider the content of the utterance H, as containing semantic information

and misinformation about it. In other words, the semantic information of the utterance H is a measure of the restriction of the domain of possibilities H, given in a closed interval [0; 1].

$$\inf(H) = \frac{M_H(A)}{M_H} \quad (1)$$

Based on the fact that

$$\inf(H) + \text{mis}(H) = 1, \\ \text{a } \inf(H) \leq 1 \text{ и } \text{mis}(H) \in [0; 1],$$

then

$\text{mis}(H) = 1 - \frac{M_H(A)}{M_H}$, where $\text{mis}(H)$ is the misinformation value of H.

Let {p, q, r, s} be variables of some language R, taking values:

p: "Group A moves to square N"

q: "Group B moves in square M"

r: "Group C moves into square O"

s: "There is a threat to the front",

a {¬; ∧; ∨; →; ≡} - operators of the language R, for which the laws of Boole and Piano axiomatics are valid, then

$$H_1: (p \vee q) \rightarrow (r \vee s)$$

$$H_2: (p \wedge q \wedge r) \equiv s$$

$$H_3: (p \wedge q \wedge \bar{r}) \equiv (s \dot{\vee} \bar{s})$$

To find semantic information and disinformation of a statement, we construct truth tables for each of the formulas.

$$H_1: (p \vee q) \rightarrow (r \vee s)$$

p	q	r	s	p ∨ q	→	r ∨ s
1	1	1	1	1	1	1
1	1	1	0	1	1	1
1	1	0	1	1	1	1
1	1	0	0	1	0	0
1	0	1	1	1	1	1
1	0	1	0	1	1	1
1	0	0	1	1	1	1
1	0	0	0	1	0	0
0	1	1	1	1	1	1
0	1	1	0	1	1	1
0	1	0	1	1	1	1
0	1	0	0	1	0	0
0	0	1	1	0	1	1
0	0	1	0	0	1	1
0	0	0	1	0	1	1
0	0	0	0	0	1	0

$$H_2: (p \wedge q \wedge r) \equiv s$$

p	q	r	p ∧ q	∧ r	≡	s
1	1	1	1	1	1	1
1	1	1	1	1	0	0
1	1	0	1	0	0	1
1	1	0	1	0	1	0
1	0	1	0	0	0	1
1	0	1	0	0	1	0
1	0	0	0	0	0	1
1	0	0	0	0	1	0
0	1	1	0	0	0	1
0	1	1	0	0	0	1
0	1	0	0	0	1	0
0	1	0	0	0	0	1
0	0	1	0	0	0	1
0	0	1	0	0	1	0
0	0	0	0	0	1	1
0	0	0	0	0	1	0

$$H_3: (p \wedge q \wedge \bar{r}) \equiv (s \dot{\vee} \bar{s})$$

p	q	r	\bar{r}	s	\bar{s}	p ∧ q	∧ \bar{r}	≡	s ∨ \bar{s}
1	1	1	0	1	0	1	0	0	1
1	1	1	0	0	1	1	0	0	1
1	1	0	1	1	0	1	1	1	1
1	1	0	1	0	1	1	1	1	1
1	0	1	0	1	0	0	0	0	1
1	0	1	0	0	1	0	0	0	1
1	0	0	1	1	0	0	0	0	1
1	0	0	1	0	1	0	0	0	1
0	1	1	0	1	0	0	0	0	1
0	1	1	0	0	1	0	0	0	1
0	1	0	1	1	0	0	0	0	1
0	1	0	1	0	1	0	0	0	1
0	0	1	0	1	0	0	0	0	1
0	0	1	0	0	1	0	0	0	1
0	0	0	1	1	0	0	0	0	1
0	0	0	1	0	1	0	0	0	1

So, let's find the value of misinformation for (H_1, H_2 и H_3) by the formula:

$$\text{mis}(H_1) = 1 - \frac{M_{H_1}(A)}{M_{H_1}}, \quad (2)$$

$$\text{mis}(H_2) = 1 - \frac{M_{H_2}(A)}{M_{H_2}}, \quad (3)$$

$$\text{mis}(H_3) = 1 - \frac{M_{H_3}(A)}{M_{H_3}}, \quad (4)$$

Substitute the values

$$\text{mis}(H_1) = 1 - \frac{13}{16} = 1 - 0,8125 = 0,1875, \quad (5)$$

$$\text{mis}(H_2) = 1 - \frac{9}{16} = 1 - 0,5625 = 0,4375, \quad (6)$$

$$\text{mis}(H_3) = 1 - \frac{2}{16} = 1 - 0,125 = 0,875 \quad (7)$$

For formulas:

$$H_4: (p \wedge q \wedge r) \rightarrow s$$

$$H_5: (p \rightarrow q) \wedge (q \rightarrow r) \rightarrow \bar{s}$$

$$H_6: (p \wedge q) \equiv r \wedge \bar{s}$$

$$H_4: (p \wedge q \wedge r) \rightarrow s$$

p	q	r	s	p ∧ q	∧ r	→ s
1	1	1	1	1	1	1
1	1	1	0	1	1	0
1	1	0	1	1	0	1
1	1	0	0	1	0	1
1	0	1	1	0	0	1
1	0	1	0	0	0	1
1	0	0	1	0	0	1
1	0	0	0	0	0	1
0	1	1	1	0	0	1
0	1	1	0	0	0	1
0	1	0	1	0	0	1
0	1	0	0	0	0	1
0	0	1	1	0	0	1
0	0	1	0	0	0	1
0	0	0	1	0	0	1
0	0	0	0	0	0	1

$$H_5: (p \rightarrow q) \wedge (q \rightarrow r) \rightarrow \bar{s}$$

p	q	r	s	\bar{s}	p → q	∧	q → r	→ \bar{s}
1	1	1	1	0	1	1	1	0
1	1	1	0	1	1	1	1	1
1	1	0	1	0	1	0	0	1
1	1	0	0	1	1	0	0	1
1	0	1	1	0	0	0	1	1
1	0	1	0	1	0	0	1	1
1	0	0	1	0	0	0	1	1
1	0	0	0	1	0	0	1	1
0	1	1	1	0	1	1	1	0
0	1	1	0	1	1	1	1	1
0	1	0	1	0	1	0	0	1
0	1	0	0	1	1	0	0	1
0	0	1	1	0	1	1	1	0
0	0	1	0	1	1	1	1	1
0	0	0	1	0	1	1	1	1
0	0	0	0	1	1	1	1	1

$$H_6: (p \wedge q) \equiv r \wedge \bar{s}$$

p	q	r	s	\bar{s}	$p \wedge q$	\equiv	$r \wedge \bar{s}$
1	1	1	1	0	1	0	0
1	1	1	0	1	1	0	0
1	1	0	1	0	1	0	0
1	1	0	0	1	1	0	0
1	0	1	1	0	0	0	1
1	0	1	0	1	0	0	1
1	0	0	1	0	0	1	0
1	0	0	0	1	0	1	0
0	1	1	1	0	0	0	1
0	1	1	0	1	0	0	1
0	1	0	1	0	0	1	0
0	1	0	0	1	0	1	0
0	0	1	1	0	0	0	1
0	0	1	0	1	0	0	1
0	0	0	1	0	0	1	0
0	0	0	0	1	0	1	0

Let's determine the size of disinformation for utterances on the second stage of the research (H_4 , H_5 , H_6):

$$mis(H_4) = 1 - \frac{15}{16} = 1 - 0,9375 = 0,0625, \quad (8)$$

$$mis(H_5) = 1 - \frac{12}{16} = 1 - 0,75 = 0,25, \quad (9)$$

$$mis(H_6) = 1 - \frac{6}{16} = 1 - 0,375 = 0,625 \quad (10)$$

TABLE 1. THE DISTRIBUTION OF SEMANTIC DISINFORMATION ACCORDING TO THE STATEMENTS H_1 , H_2 , H_3 , H_4 , H_5 , H_6

Experience № 1		Experience № 2	
	$mis(H)$		$mis(H)$
H_1	0,1875	H_4	0,0625
H_2	0,4375	H_5	0,25
H_3	0,875	H_6	0,625

Diagnosis of disinformation factor. The diagnosis of the influence of semantic disinformation utterance on the choice of subjects in Experiments 1–2 was carried out through regression analysis.

Diagnosis of rationality of thinking. To assess the influence (or absence) of logical literacy and rationality of the subjects on making quick or slow decisions, a subtest was used, which analyzed “Logical competence” and “Subjective assessment of logical competence” of the subjects. The subtest data were subjected to Spearman correlation analysis.

To calculate descriptive statistics of experimental results, correlation and regression analysis, as verification of the obtained data, the IBM SPSS 22 statistical software package was used.

TABLE 2. KRUSKAL–WALLIS ONE-WAY ANALYSIS OF VARIANCE

Index	$M \pm S$ (N=22) Group 1	$M \pm S$ (N=22) Group 2	$M \pm S$ (N=22) Group 3	$M \pm S$ (N=22) Group 4	$M \pm S$ (N=21) Group 5	Level P (df=4)
Participants	17,91	17,95	17,82	17,82	17,95	
Age	$\pm 0,53$	$\pm 0,49$	$\pm 0,39$	$\pm 0,39$	$\pm 0,38$	0,7386
Logical competence	1,45 $\pm 0,51$	1,55 $\pm 0,51$	1,55 $\pm 0,51$	1,55 $\pm 0,51$	1,29 $\pm 0,46$	0,3639
Subjective assessment of logical competence	2,64 $\pm 0,66$	2,64 $\pm 0,58$	2,09 $\pm 0,61$	2,18 $\pm 0,50$	2,14 $\pm 0,48$	0,0003
Choice 1	2,09 $\pm 0,61$	2,27 $\pm 0,63$	2,55 $\pm 0,67$	2,68 $\pm 0,57$	2,57 $\pm 0,68$	0,0064
The value of semantic misinformation	0,73 $\pm 0,25$	0,72 $\pm 0,23$	0,69 $\pm 0,26$	0,74 $\pm 0,22$	0,71 $\pm 0,25$	0,9579
Choice 2	4,86 $\pm 0,89$	4,95 $\pm 0,90$	4,82 $\pm 0,85$	4,86 $\pm 0,83$	4,86 $\pm 0,85$	0,9911
The value of semantic misinformation	0,28 $\pm 0,25$	0,31 $\pm 0,25$	0,27 $\pm 0,24$	0,29 $\pm 0,25$	0,28 $\pm 0,24$	0,9892

Spearman's correlation analysis reveals a direct and positive relationship between the semantic disinformation value of the message ($mis(H)$) and the choice of subjects, both in Experiment №1 (0.65) and in Experiment № 2 (0.93) in the confidence interval (CPI = 95%). A link was also found

VII. RESULTS

The results of the selection of subjects in Experiments 1–2 are presented in the diagrams below (see Diagram 1, Diagram 2).

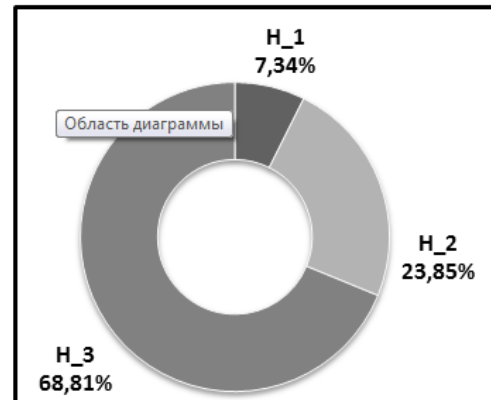


Diagram № 1. The results of the selection of subjects in Experiment 1

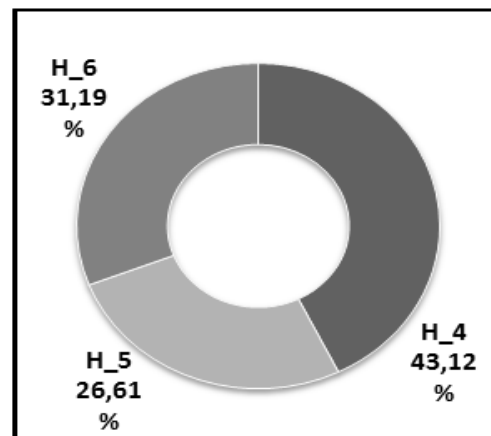


Diagram № 2. The results of the selection of subjects in Experiment 2

Descriptive statistics of test results in Experiments 1–2 are presented in the table below (see Table No. 2).

between the choice of subjects (0.46). This suggests that most of the subjects after the completion of the first experiment, when they were required to make a choice in a short time ($t \leq 1$ min), were aware of the fact that the choice they made is not optimal for some reason. In an interview with the subjects

immediately after the questionnaires were submitted, the overwhelming majority valued skeptical of their choice. This forced us to conduct an additional survey of the subjects regarding a subjective assessment of the correctness of their choice. The overwhelming majority (64.42%; SD = 0.218) expressed dissatisfaction with their answer. (81.05%; SD = 0.088,) noted that the main reason for their failure is the timing of the assignment, (18.95%; SD = 0.104), which is an insufficient level of LC. The experience of failure to perform the task during the first experiment significantly influenced (0.46) the choice in the second.

It is interesting that the end of the second experiment, the results of a survey of the subjects significantly changed. So (69.8%; SD = 0.061) were satisfied with their choice, and among those who were not satisfied with their choice (87.72%; SD = 0.194), the main reason for their setback was not the time factor, but insufficient LC level.

During the analysis, it was also established that the age factor of the subjects showed a lack of connection with all the

predictors considered. This is explained by the fact that the age ranks of the subjects differed slightly from each other.

Also from the data in the table, one can trace a subtle connection between the level of logical competence and the subject assessment of logical competence (0.17), which indicates that the subjects did not rely on their knowledge of logical thinking in their own assessment. This led to our opinion: 1) on the one hand, to an overestimation of their logical skills, 2) on the other hand, to its underestimation.

It is interesting that, the predictors of LC and SALC showed, in the first case, a barely noticeable relationship (0.07), and in the second, at all, its absence (-0.06) with the choice of the subjects during the first experiment. However, when comparing these factors with the results of the choice of the subjects, in the second experiment a stable relationship with indicators LC (0.46) and SALC (0.39) is found. This suggests that the conditions themselves for the second experiment ($t \leq 60$ min) allowed the subjects to use all of the cognitive mechanisms of logically correct and rational decision-making tools that they had.

TABLE 3. SPEARMAN'S RANK CORRELATION COEFFICIENT

Index	Age	LC	SALC	Choice 1	<i>mis</i> (H_1, H_2, H_3)	Choice 2	<i>mis</i> (H_4, H_5, H_6)
Age	1	-0,01	-0,05	-0,07	-0,14	-0,01	-0,06
LC	-0,01	1	0,17	0,07	-0,09	0,46**	0,37**
SALC	-0,05	0,17	1	-0,06	0,39**	0,39**	0,31**
Choice 1	-0,07	0,07	-0,06	1	0,65**	0,46**	0,48**
<i>mis</i> (H_1, H_2, H_3)	-0,14	-0,09	0,39**	0,65**	1	0,47**	0,49**
Choice 2	-0,01	0,46**	0,39**	0,46**	0,47**	1	0,93**
<i>mis</i> (H_4, H_5, H_6)	-0,06	0,37**	0,31**	0,48**	0,49**	0,93**	1

** $p < .01$

VIII. PREDICTORS OF THE CHOICE OF SUBJECTS IN EXPERIMENT № 1 AND № 2

For data analysis, linear regression analysis was used, in which Choice 1 and Choice 2 were shown as dependent variables. Two models were tested: Model 1 included age, logical competence, subjective assessment of logical competence, and semantic disinformation as predictors; Model 2 included the same demographic, appraisal and rational predictors and also size of semantic misinformation, different from the first model.

The "Choice 1" and "Choice 2" indicators in both models demonstrated a significant contribution of the analyzed predictors to decision making: Model 1 revealed a significant contribution to decision making on the size of semantic disinformation, logical competence and subjective assessment of logical competence ($F = 3,105$, $R = 0,75$, Adjusted $R^2 = 0.55$, $p = 7.58E-19$); in Model 2, a change in the experimental conditions led to a significant deviation from the results in the first ($F = 4,104$, $R = 0.903$, Adjusted $R^2 = 0.81$, $p = 2.88 E-32$).

For the "Choice 1" indicator, it was found that the significant predictor is the value of semantic disinformation ($b = 2.29$, $\beta = 0.83$, $\alpha < 0.0001$). Almost the same results were obtained for the "Choice 2" indicator in Model 2 ($b = 2.75$, $\beta = 0.78$, $\alpha < 0.0001$). Indicators of logical competence demonstrated in Model 1 a slight impact on the choice of subjects ($b = 0.19$, $\beta = 0.25$, $\alpha = 0.0048$) and its absence from the subjective assessment of logical competence ($b = -0.38$, $\beta =$

-0.41 , $\alpha = 0.000001$). Indicators of logical competence, subjective assessment of logical competence and age - demonstrated in Model 2 a modest impact on the choice of subjects ($b = 0.17$, $\beta = 0.28$, $\alpha = 0.00295$; $b = 0.13$, $\beta = 0.18$, $\alpha = 0.002844$; $b = 0.05$, $\beta = 0.11$, $\alpha = 0.175532$).

TABLE 4. REGRESSION MODEL OF PREDICTORS RELATIONSHIP IN EXPERIMENT 1

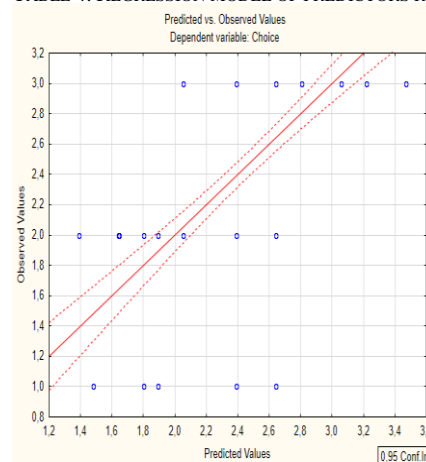
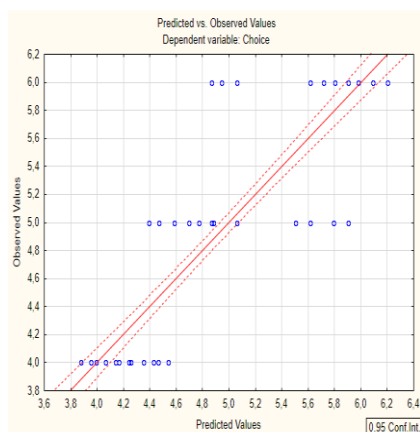


TABLE 5. REGRESSION MODEL OF PREDICTOR RELATIONSHIPS IN EXPERIMENT 2



Indicators of multiple regression and the edited coefficient of determination indicate that the predictors in question, with the exception of the amount of misinformation, do not affect the choice of subjects.

IX. DISCUSSION

First of all, it is necessary to specify that the concepts "semantic disinformation" or "size of semantic disinformation" used in this research considerably differ from the widespread term "disinformation". In our case, semantic disinformation is understood as a certain part of semantic contents of any utterance which increases entropy (or uncertainty) utterance in general. From the point of view of mathematical logic, the size of semantic disinformation is directly proportional to logical feasibility of a formula and respectively to its logical probability.

However, logical probability (information) and logical impossibility (disinformation) do not speak of absolute truth or lie of utterance.

At the same time, the results received during the research testify to the following:

- 1) the size of semantic disinformation of a statement influences adoption of fast decisions;
- 2) indicators of rationality of thinking (logical competence and value judgment of logical competence) don't influence adoption of fast decisions;
- 3) the age factor hasn't shown interrelation with the considered predictors. At the same time, it should be taken into account the fact that in the analysis of results of researches of subjects of advanced age the interrelation between age and success of the solution of cognitive tasks is observed (W. Eberhardt, W. B. de Bruin, & J. Stroogh, 2018);

4) results of researches of 4 variable formulas correspond to the previous researches conducted from the 1, 2 and 3 by variable formulas of statements (A.S. Emelyanov, 2016, 2018). It is interesting that distribution of results of an experiment for the cognitive task consisting of three options of the choice approaches Fibonacci's distribution.

In this regard, there is a need to continue researches in this subject domain for the purpose of obtaining results for formulas of language of the utterance consisting of five and more variables. On the other hand, a promising direction can be an appeal to more complex levels of logical analysis and richer languages of logic, in particular, the paraconsistent logic C_n , which is a development of algebra da Costa. Appeal to the systems of logic that are built on the basis of algebra da

Costa, will allow a different look at the subject of semantic information and disinformation, the classical description of which is built, as we recall, on the concept of "logical contradiction". Changing the tool for analyzing the magnitude of disinformation will lead to the transformation of factors considered as predictors of choice and, therefore, to the formulation of a new cognitive behavior model with quick decisions in a situation of uncertainty.

It is also worth paying attention to the need to design a fundamentally new model of behavior in the implementation of quick decisions. In the course of the study, it was revealed that Model 2 perfectly describes the behavior of subjects under conditions of slow decision-making. However, a rational interpretation of the behavior of subjects, tested in Model 1, showed that logical competence does not have a positive effect on choice.

The obtained results expand the theoretical and methodological significance of the value of semantic disinformation and allow it to be used in evaluating fast and slow solutions. The integration of logical content and behavioral decision-making mechanism sets a new vector for research within the framework of decision theory. One of the main consequences of this approach is the prospect of further analysis of large amounts of information (text, audio or video content), in order to identify such logical structures that lead to cognitive distortions as part of a quick decision-making strategy. Despite the stability of the results obtained in the research of the effect of semantic disinformation on making quick decisions, there are a number of issues worthy of attention. Primarily, it concerns the determination of the boundaries of the fast and slow solutions themselves. Namely, the moment when the influence of semantic disinformation is insignificant on the choice of subjects. Secondly, with the identification of factors that most fully reveal the decision-making mechanism in the tested Model 1.

The research undertaken within the framework of this article does not claim to be the ultimate truth. On the contrary, it sets a certain vector in the development of the theory of decision making and the theory of semantic information.

Acknowledgement

I thank Dmitry Gruner for his help in the statistical processing of experimental data.

Reference

- [1] V.A. Vishnyakov (2014). State, trends and the concept of the development of intellectual technologies in the protection of information. Open Semantic Technologies for Intelligent Systems, 391–394.
- [2] O.V. Zerkal (2014). Semantic information and approaches to its evaluation. Philosophy of Science, 1 (60), 53–69.
- [3] A.N. Kolmogorov (1957). Theory of Information Transmission // Session of the USSR Academy of Sciences on the scientific problems of industrial automation, October 15–20, 1956: Plenary meeting M.: Publishing House of the Academy of Sciences of the USSR, 66–99.
- [4] T.V. Kornilova (2016a). Intellectual personal potential of a person in conditions of uncertainty and risk. SPb.: Nestor-History.
- [5] T.V. Kornilova (2016b). The psychology of choice as a mental and personal mediation of overcoming uncertainty. Psychological Journal, 37 (3), 113–124.
- [6] E.V. Krasnov (2017) Personalities and intelligence as predictors of decision making in Iowa test game strategies (in a sample of military leaders). Experimental psychology 10 (2), 54–66. doi: 10.17759 / expsy.2017100205.

- A. Nikiforov (2009). Conditional counterfactual statements. *Logos*, 2 (70), 84–95.
- [7] O.A. Pogorelov (2013). Sketch of the theory of semantic information and disinformation.
- [8] Herald of the East Ukrainian NAT. UN-Tu im. V. Dahl 1(190), 281–285.
- [9] P. Adriaans (2019).
- [10] Adriaans P. (2019). A critical analysis of Floridi's theory of semantic information. *Knowledge, Technology and Policy*, 1–2 (23), 41–56.
- [11] Aisbett J., Gibbon G. (1999). A practical measure of the information in a logical theory. *Journal of Experimental and Theoretical Artificial Intelligence*, 2 (11), 201–218.
- [12] Bar-Hillel Y., Carnap R. (1953). Semantic information. *The British Journal for the Philosophy of Science*, 4(4), P. 151.
- [13] Carnap R., Bar-Hillel Y. (1952). An outline of theory of semantic information. *Techn. Report of Res. Lab. Electr.*
- [14] Damasio, A. R., Everitt, B. J., & Bishop, D. (1996). The somatic marker hypothesis and the possible functions of the prefrontal cortex [and discussion]. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 351 (1346), 1413–1420. doi:10.1098/rstb.1996.0125.
- [15] Eberhardt W., de Bruin W. B., & Stroogh J. (2018). Age differences in financial decision making: the benefits of more experience and less negative emotions. *Journal of Behavioral Decision Making*,
- [16] Emelyanov A.S. (2018). Theory of Decision-making: the logical-mathematical aspects. *International Journals of Advanced Studies*, Vol. 8, No 2, 22–39. doi: 10.12731/2227-930X-2018-2-22-39.
- [17] Emelyanov A.S. (2015). Logical-mathematical analytics the existential nature of Decision-making. *International Journals of Advanced Studies*, Vol. 5, No 4.
- [18] Ert, E., Erev I. (2007). Replicated alternatives and the role of confusion, chasing, and regret in decisions from experience. *Journal of Behavioral Decision Making*, 20, 305–322. doi: 10.1002/bdm.556.
- [19] Evans, J. St. B. T. (2003). In two minds: Dual process accounts of reasoning. *Trends in Cognitive Sciences*, 7, 454–459.
- [20] Evans, J. St. B. T. (2004). Dual processes, evolution and rationality. *Thinking and Reasoning*, 10, 405–410.
- [21] Floridi L. (2005). Is information meaningful data? *Philosophy and Phenomenological Research*, 2(70), 352, 353.
- [22] Floridi L. (2004). Open problems in the philosophy of information. *Metaphilosophy*, 4(35), 554–582.
- [23] Floridi L., (2004). Outline of a theory of strongly semantic information. *Minds and Machines*, 2(14), 197–222.
- [24] Floridi L., (2009). Philosophical conceptions of information. *Formal Theories of Information* / Ed. by G. Sommaruga. B.: Springer, 16.
- [25] Grosskopf, B., Erev, I., & Yechiam, E. (2006). Forgone with the wind: Indirect payoff information and its implications for choice. *International Journal of Game Theory*, 34, 285–302.
- [26] Gu, X., Mulder, J., Dekovic, M., & Hoijtink, H. (2014). Bayesian evaluation of inequality constrained hypotheses. *Psychological Methods*, 19(4), 511–527. doi:10.1037/met0000017.
- [27] Gu, X., Mulder, J., & Hoijtink, H. (2015). Error probabilities in default Bayesian hypothesis testing. *Journal of Mathematical Psychology*. doi:10.1016/j.jmp.2015.09.001.
- [28] Hellriegel, D., Slocum, J.W., & Woodman, R.W. (1998). *Organizational behavior* (8th ed.). SouthWestern: Cincinnati, Ohio, USA.
- [29] Hoijtink, H. (2012). *Informative hypotheses: Theory and practice for behavioural and social scientists*. Boca Raton, FL: Chapman and Hall/CRC.
- [30] Kahneman, D., & Tversky, A. (1996). On the reality of cognitive illusions. *Psychological Review*, 103, 582–591.
- [31] Kahneman, D., & Tversky, A. (Eds.). (2000). *Choices, values and frames*. New York, USA: Cambridge University Press.
- [32] Kornilova T.V., Kerimova S. G. (2018). Specifics of Personal Prerequisites of Decision-Making Process (Based on the Framing Effect) in Doctors and Teachers Sample Groups. *Psychology. Journal of the Higher School of Economics*, 1 (15), 22–38.
- [33] Kugler T., Rapoport A., & Pazy A. Public good provision in inter-team conflicts: effects of asymmetry and profit sharing rule. *Journal of Behavioral Decision Making*, 23, 421–438. doi: 10.1002/bdm.667.
- [34] Löckenhoff, C. E. (2011). Age, time, and decision making: From processing speed to global time horizons. *Annals of the New York Academy of Sciences*. 1235: 44–56. doi:10.1111/j.1749-6632.2011.06209.x.
- [35] Michalakiewicz M., Arden K., & Erdfelder E. (2018). Do smarter people employ better decision strategies? The influence of intelligence on adaptive use of the recognition heuristic. *Journal of Behavioral Decision Making*, 31, 3–11. doi: 10.1002/bdm.2040.
- [36] Milo J., Silberzahn P. (2013). *Constructing Cassandra, Reframing Intelligence Failure at the CIA, 1947–2001*. Stanford University Press. 375 p.
- [37] *Psychology of Intelligence Analysis*. by Richard J. Heuer, Jr. Center of the study of intelligence. Central Intelligence Agency, 1999.
- [38] Randolph H. Pherson and Richards J. Heuer Jr., as well as Roger Z. George, (2004). Fixing the Problem of Analytical Mind-sets: Alternative Analysis. *International Journal of Intelligence and Counterintelligence* 3(17), 385–404.
- [39] Shannon C.E. (1948) A mathematical theory of communication. *Bell System Technical Journal*, 27(3), 379–423.
- [40] Thaler, R., Tversky, A., Kahneman, D., & Schwartz, A. (1997). The effect of myopia and loss aversion on risk taking: An experimental test. *The Quarterly Journal of Economics*, 112, 647–661.
- [41] Thomas, A. K., Millar, P. R. (2012). Reducing the framing effect in older and younger adults by encouraging analytic processing. *The Journals of Gerontology*, 2, 139–49.
- [42] Toplak M.E., Liu E., Macpherson R., Toneatto T., & Stanovich K. E. (2007). The reasoning skills and thinking dispositions of problem gamblers: a dual-process taxonomy. *Journal of Behavioral Decision Making*, 20, 103–124. doi: 10.1002/bdm.544.
- [43] Tversky, A., & Kahneman, D. (1983). Extensional versus intuitive reasoning: The conjunction fallacy in probability judgment. *Psychological Review*, 90, 293–315.
- [44] Yechiam, E., Stout, J. C., Busemeyer, J. R., Rock, S. L., & Finn, P. R., (2005b). Individual differences in the response to forgone payoffs: An examination of high functioning drug abusers. *Journal of Behavioral Decision Making*, 18, 97–110.
- [45] Watanabe, S.; Shibutani, H. (2010). Aging and decision making: Differences in susceptibility to the risky-choice framing effect between older and younger adults in Japan. *Japanese Psychological Research*. 52 (3): 163. doi:10.1111/j.1468-5884.2010.00432.x.
- [46] West, R. F., & Stanovich, K. E. (2003). Is probability matching smart? Associations between probabilistic choices and cognitive ability. *Memory & Cognition*, 31, 243–251.