PERSONALITY AND INFORMATION PROCESSING: A COMPUTER-ASSISTED TECHNIQUE OF PREDICTING AGENT'S ACTIVITY AND EMOTIONAL STABILITY

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Abstract

A computer-based information-processing technique, simulating the process of information exchange between the "virtual pilots" and "flight controllers", patented by the authors as a "Method of predicting the individual's stability to failure stress" (patent of Ukraine №91842, 2010) has been empirically proved to be predictive of the individual's agentic activity as well. The conclusion was made on a sample of 60 participants, split into 2 clusters (K-means algorithm), by comparing their personality characteristics and the modes of information processing. One of the cluster's participants demonstrated the abilities to simultaneously attend to the two different perceptual activities (identifying "call-names" and processing the visually perceived information) and equally high levels of efficacy of performance of both activities. The members of another cluster concentrated on one of the activities, partially ignoring the instruction to identify call-names, which is claimed to be a sign of susceptibility to stress. The clusters with different modes of information processing appeared to differ statistically significantly by t-test: on their psychological well-being measures, the strategies and attributions preferred and coping strategies. Between-cluster differences are significant: on the key strategies and attribution scales: success-expectation scale ($t=8{,}87$, $p \leq .001$); the master-orientation scale ($t=8{,}17$, $p \leq .001$), and task-irrelevant behavior scale ($t= -8{,}99$, $p \leq .001$); as well as on all the scales of psychological well-being and coping behavior. The results clearly suggest the conclusion about the validity of the technique for predicting both: the emotional stability and the agentic activity of the individual.

Keywords: Agentic activity, emotional stability, information-processing, computer-based technique, personality characteristics

Introduction

Personality traits have been reported to correlate with "a multitude of objective indices of information processing" (Matthews, G., 2008). As the above cited author points out, it was the pioneering psychological trait theorist, Hans Eysenk, who introduced experiments that

related traits to performance tasks requiring attention, memory and other cognitive functions. Since then personality researchers began to look for cognition qualities, such as locus of control and dispositional focus of attention as the aspects of personality assessment. Michael Eysenk (2001) reviewed studies relating extraversion to standard information-processing tasks, such as attention, memory, guided responses, motor skills, problem solving and strategy choice. In his later publications he with coauthors (Eysenck, M., Derakshan, N., 2011; Derakshan, N., Smyth, S., Eysenck, M., 2009) described new perspectives in attentional control theory and effects of state anxiety on performance using a task-switching paradigm.

Experimental psychologists provided new chronometric paradigms for studying vigilance as a distinguishing feature of introverts (Warm, J.S., Dember, W.N., Murphy, A.Z, Dittmar M.L., 1992; Warm J.S. & Dember W. N., 1998). Differences in the latencies of responses to the visually displayed images of social objects are ascribed to the implicit *prejudices* against those objects (Egloff, B., Schumkle, S., 2005). *Intensity of prejudices*, implicitly assessed by chronometric measures, is related, in its turn, to the positivity/ vs. negativity of the global traits (Nosenko, E., Tischenko V., 2010). Chronometric measures are also used in the implicit computer-based assessment of such personality constructs as self-concept, self-esteem, differences between the real and ideal selves (Asendorpf, J.B., Banse, R., & Mücke, D., 2002; Greenwald, A.G. & Banaji, M.R., 1995; Greenwald, A.G., Banaji, M.R. et al., 2002).

The authors of this paper (Nosenko, E., Kovriga, N., 2003) substantiated and empirically examined the validity of an information-processing approach to assessing the level of *emotional intelligence*, attained by the individual, which is based on evaluating the degree of impulsivity of the individual's responding to an emotionally-charged stimuli in terms of the latency of responses, measured in oral speech. An instantaneous response (generated on the sensory-perceptive level) with low latency of responding is considered to correspond to the lowest level of emotional intelligence. The response, mediated by thinking, i.e. having longer latency, corresponds to the intermediary level of emotional intelligence, whereas short latencies of responding to a class of the functionally equivalent situations are claimed to correspond to the highest level of emotional intelligence, at which responding to the emotionally-charged stimuli is exercised on the level of sets (convictions). The latter finding shows, though, that the meaning of the above described correlations between the information-processing measures and personality characteristics needs to be deeply investigated not only in the laboratories, but in the outcomes observed in the real-life settings. Moreover, correlations between traits and measures of information processing are generally of modest magnitude, unlike the intelligence measures.

The description of the method used in this research

When planning the research, the empirical results of which are presented in this paper, we tried to stick to the major principles of the cognitive theory, in accordance with which a cognitive task performance not only depends on multiple mechanisms, but these mechanisms are also highly heterogeneous in nature.

The cognitive task, we used in this research, is described in our patent (Arshava, I., Nosenko, E., Khizha, O., 2010) and was investigated in our studies oriented toward predicting the proneness of the individual to a failure stress (Arshava, I., Nosenko E., 2008, 2010, 2013).

It was designed so as to simulate the process of information exchange between two interlocutors: a pilot and a flight controller. The individual, whose proneness to failure stress is assessed, is expected to perform simultaneously two interrelated cognitive tasks: 1) identifying the virtual interlocutor's "call name" and the "call name" assigned to him/her by clicking them in the appropriate menus or orally and 2) identifying the location of the figures, visually presented on the map (See Fig.1).

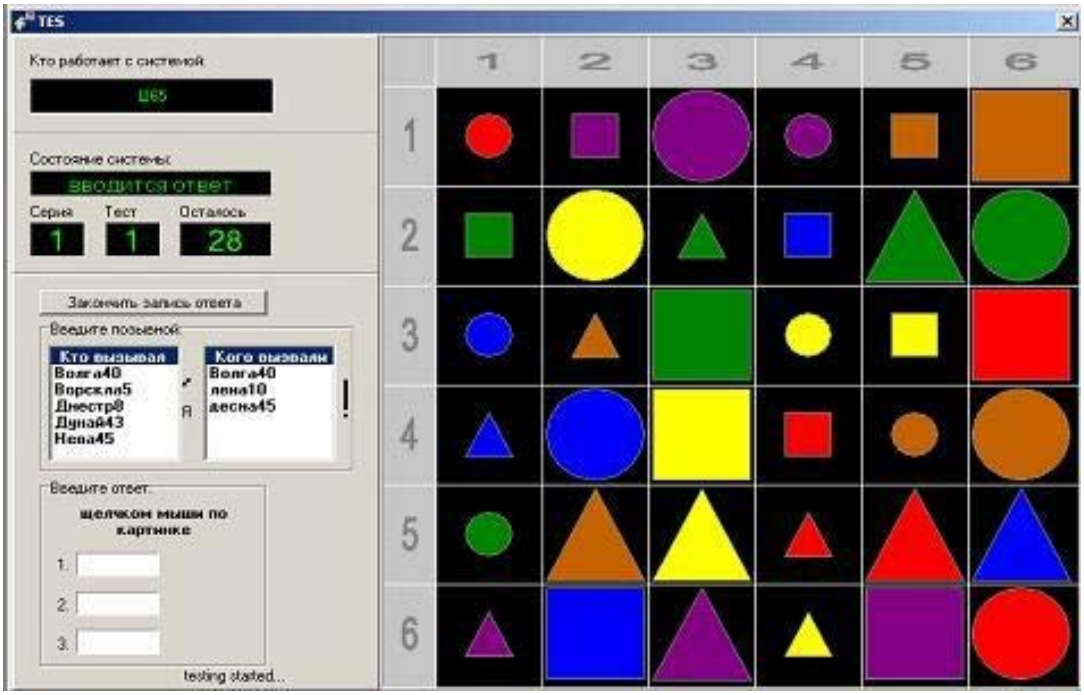

Fig. 1. Multi-colored geometrical figures of 3 different shapes, 2 sizes and 6 colors, presented to the subjects in the visual form. *Note:* In the left-hand side of the figure there are two menus to register the user's 'call names' and those of the virtual interlocutor.

When performing the first set of assignments (20 questions), the recipients had to process the amount of information which does not exceed the human short-term memory capacity. In the second set of assignments (20 questions) the amount of information to be processed is increased beyond the maximum short-term memory capacity which dooms the recipients to an unavoidable (or hardly controllable) failure, likely to elicit failure stress in the individuals susceptible to stress. In the third set of assignments (also containing 20 questions) the initial conditions of information presentation are renewed.

Susceptibility to failure stress is implicitly assessed on the basis of the statistically significant differences in the multidimensional cognitive behavior measures, characterizing the differences in the efficacy of information processing in the situations after failure and prior to it. The measures include three groups of parameters: 1) quantitative: efficacy of performance characteristics (number of correctly identified geometrical figures and call names); 2) modes of information processing chosen by the recipients in the course of the simultaneous enacting of the two interrelated types of activities: identifying the locations of the figures on a visually displayed map and reporting call names, the modes being intuitively-simultaneous (constructive) or reflective-consecutive (non-constructive) (Kuhl, J., Wassiljev, J., 1985); 3) hesitation phenomena in oral speech of the subjects are recorded during the oral exchange of information (latencies of responses, an average continuity of a speech utterance pronounced without hesitation pauses, (250 ms and longer) overall duration of performance and the like, earlier found out to signal an emotional tension of the speaker (Nosenko, E., 1981; Goldman-Eisler, F., 1967).

The above described approach to the design of the computer-simulated method of assessing stability vs. susceptibility to failure stress allows assessing the following aspects of self--regulative efficacy after experiencing an uncontrollable failure: 1) the degree of retention of the *structure of goals*, 2) *frustration tolerance*, and 3) the *degree of activity* manifested towards the achievement of the goals.

We observed in the course of testing the prognostic validity of the designed method that individuals demonstrated different patterns of behavior related to their goal-setting and goal-striving 1. Some of them retained the initial structure of the goals (prescribed by the

instruction in the initial set of assignments), and simultaneously attended to the both interrelated types of activities modeled, namely reported 'call names' and identified the figures on the visually displayed map. When fulfilling the second set of assignments, they quickly realized that the goals were unattainable and either abandoned them altogether or fulfilled the assignments partially. The unavoidable failure did not tell though on their performance efficacy in the *third series* of assignments. They managed even to increase the number of correctly answered questions in the third series of assignments or retained the original efficacy level, demonstrated in the first series of assignments.

Other individuals failed to equally distribute their attention between the two interrelated assignments and abandoned one of them either entirely or partially, demonstrating the so called reflective-consecutive mode of information processing (unlike the intuitive–simultaneous one displayed by the subjects who appeared more successful in their self-regulation efforts). After experiencing an unavoidable failure less efficacious subjects failed to cope with the assignments presented in the third serious and demonstrated a lower level of efficacy than that prior to failure, despite the fact that conditions for their fulfillment became favorable again. They continued to neglect one of the goals (reporting the call names) and concentrated their attention on the assignment they considered to be more significant the identification of the figures displayed on the map. This mode of self-regulative behavior signals *operational tension*. It was observed in the real-life stressful situations and was described in the literature on reactions of the astronauts to professional stress as indicative of the stress vulnerability (Beregovoy, G. G., Zhdanov, O. I., 1992).

The self-regulation patterns of this group of individuals were also characterized under failure-threat conditions either by the persistent attempts to cope with an unavoidable failure, manifested by the longer latencies of responses, or by the formal simulation of the external activity. Thus, observations on the level of individual cases showed differences in goal-setting behavior of the individuals, susceptible to stress, (abandoning one of the goals); frustration tolerance (reducing efficacy of performance after failure), setting different standards of activity toward achieving the goals (between-subject differences in the quantitative characteristics of performance under similar conditions)**.**

Testing the validity of the method for predicting the agentic activity

The major objective of this study was to examine the possibility of extending the prognostic potential of the patented technique as a means of predicting the *agentic activity* of the individuals, who fulfilled this test. We followed some of the assumptions of the methodology of modeling the behavior of the "social agents", used in social sciences (Schmidt, B., 2000). We have chosen as potential measures of the *agentic activity* displayed in the course of the cognitive-task performance the following indices:

1) a maximum average numbers of the correctly identified „call names" and „the figures", displayed on the map, as predictive of the *achievement motivation* and *conscientiousness* of the individuals;

2) the degree of the continuity of maintaining *stability* of the efficacy characteristics of cognitive task performance (assessed in terms of the variations of the *latencies* of responses) as indicative of the *endurance* of the individuals;

3) the *asymmetry* in performance characteristics of the two interrelated tasks on different stages of the testing procedure, as indicative of the ability to *divide attention* between two interrelated tasks, interpreted as an index of *frustration tolerance*.

The above innumerated characteristics of the efficacy of the cognitive task performance are claimed (Ilyin, E. P., 2005) to be indicative of the professional efficiently of the individuals.

To verify the prognostic validity of the patented technique as a possible means of predicting the *agentic activity* a quasi-experimental research was carried out.

Method

Participants

There were several groups of participants: university undergraduates (55 persons); secondary school teachers (60 persons); air-flight controllers (55 persons).

To illustrate the results obtained we have chosen on the sample of participants – 60 secondary school teachers, aged 28 -50. The sample included 78.3 % (N=47) females and 21.7 % (N=13) males.

Materials

Coping Inventory for Stressful Situations (CISS)

The Coping Inventory for Stressful Situations was used to measure the tendencies of the individuals to resort to the: *task* - , *emotion* -, and *avoidance-focused* coping strategies (Endler & Parker, 1999, adapted to the Ukrainian culture in 2004 by Krukova). The measure consists of 46 items to which subjects respond on a seven-point Likert scale ranging from 1 – "strongly disagree", to 7 – "strongly agree". The stem question requests that individuals rate how much they engage in each activity when they encounter difficult, stressful or upsetting situations. Sample items for the respective subscales include: task-oriented coping, "Think about how I solved similar problems"; emotion-oriented coping, "Blame myself for not knowing what to do"; and avoidance-oriented coping, "Watch TV; call a friend". Reliability and validity estimates for the Ukrainian adaptation of CISS provide support for internal consistency of all the scales. Cronbach α = .876 for the whole inventory, α = .853 for the problem-focused coping; α=.877 for emotion–focused coping and α=.814 for the avoidance coping.

NEO Five-Factor Inventory (NEO-FFI)

NEO Five-Factor Inventory (Costa et al., 1992, adapted by V. Orel) is a 60-item inventory, comprising questionnaires for measuring the Big Five personality factors. Participants in our study rated 60 behavior-descriptive statements on 7-point Likert scales, ranging from 1 (strongly disagree) to 7 (strongly agree), indicating the degree to which they thought the items were characteristic of them. The NEO-FFI is one of the most widely used measurement tools of the Big Five and has very strong psychometric properties. Six-year test-retest reliability has ranges from .63 to .82. For the NEO FFI (the 60-domain-only version), the internal consistencies were: for neuroticism α=.79; extraversion α=.79; openness to the new experience α=.68; agreeableness α =.75; conscientiousness α=.83. Adapted version Cronbach alphas reliabilities were reported as follows: E = .76, N = .63, O = .75, C=.73, A=.79.

Psychological Well-Being (PWB)

The multidimentional inventory of PWB (Ryff, C.,1989) is an 84-item scale which assesses the goal of reaching human potential and having a meaningful life. The scale includes six components: self-acceptance (α = .77), environmental mastery (α = .80), purpose in life (α = .77), positive relations with others (α = .74), personal growth (α = .78), and autonomy (α = .87). The subjects respond to the items on a seven-point Likert scale ranging from 1 – "strongly disagree" to 7 – "strongly agree". Reliability and validity estimates for the Ukrainian adaptation of PWB (Karskanova S.V., 2011) support the internal consistency of all the scales with Cronbach's alpha: .75 for self-acceptance; .73 for environmental mastery, .74 for purpose in life, .73 for positive relations with others , .74 for personal growth, and .78 for autonomy. These data demonstrate the adequacy of the Ukrainian translation.

The Strategy and Attribution Questionnaire (SAQ)

The Strategy and Attribution Questionnaire (SAQ) offered by Jari-Erik Nurmi, Katariina Salmela-Ago, Tarja Haavisto in 1995, is a 60-item self-report scale for measuring cognitive and attributional strategies which influence the extent to which people are successful in various situations. The statements form 10 scales: five for the *achievement*

situations (success expectations, task-irrelevant behavior, seeking social support, reflective thinking, master-orientation) and five for the situations of *affiliation* (success expectations, pessimism, avoidance, task-irrelevant behavior, master-orientation). The are responded on a 4-point scale with 1 - strongly disagree to 4 - strongly agree. The questionnaire was adapted in Ukraine by Dukhnevych,V.N. in 2000. The reliability of the internal consistency for the scales varies from 0.69 to 0.60.

Procedure

The sample was split into 2 clusters (K-means algorithm) on their cognitive performance variables. Three measures were obtained: 1) number of correctly identified "figures"; 2) number of correctly identified "call names" and 3) asymmetry between correctly identified "figures" and "call names", computed in percentage for each of the three series of the computer-based information processing assignments (each comprising 20 questions).

Results

The participants' data appeared to differ statistically significantly (by t-test) on the number of correctly identified "call names" and "figures" between the first and the third sets of assignments. The results of the second set of assignments were not compared, since they were designed to doom the participants of both clusters to failure by increasing the information load in them to exceed the short-term memory capacity (see table 1).

Table 1. Between-cluster (1st vs. 2nd) differences in performance characteristics

Cognitive task performance variables in different series of assignments		**Mean values**		**t-test**	**Differences fit goodness by t-test (for independent samples) at:**
		Cluster 1	**Cluster 2**		
„Call names"	1 series	14.197	12.346	2.218	.0317
	3 series	15.121	8.538	12.315	.0001
„Figures"	1 series	14.977	12.058	3.087	.0035
	3 series	15.576	13.846	2.097	.0418
Asymmetry (%)	1 series	8.664	25.369	-3.363	.001
	3 series	5.618	44.778	-21.833	.0001

It is evident, that the participants of the first cluster correctly identified approximately 2/3 of the total number of assignments, whereas the participants of the second cluster had statistically significant differences in their cognitive-task performance efficacy. Their asymmetry measures also differed significantly (by t-test). The results suggest that the participants of the first cluster equally high goals to achieve efficacy in both interrelated cognitive activities, which can be claimed indicative of their higher achievement motivation and conscientiousness. Significant differences in the asymmetry characteristics can predict the higher level of frustration tolerance of the participants of the first cluster.

Table 2 presents the results which illustrate statistically-significant differences between the two clusters in their personality characteristics, claimed to be likely determinant of the cognitive performance differences.

As shown in Table 2, the participants of the "opposite" clusters, formed by the method of cluster analysis on the results of their cognitive performance indices, appeared to statistically significantly differ on *extraversion* ($t = 3.170$, $p<.01$); *conscientiousness* ($t = 2.989$, $p<.01$); *openness to a new experience* ($t = 6.270$, $p<.000$) and *neuroticism* ($t = -6.46$, $p<.000$).

Table 2. Explicitly assessed measures of the participants' personality characteristics

List of Inventories and their scales	Mean values		t value	P
	Cluster 1	Cluster 2		
Big Five extraversion	25.052	15.462	**3.170**	.002
agreeableness	26.636	26.936	-0.080	.936
conscientiousness	28.212	18.486	**2.989**	.0045
neuroticism	14.714	25.692	**-6.463**	.0001
openness to a new experience	28.517	20.872	**6.170**	.0001
CISS Task-focused coping	61.485	51.769	**4.282**	.0001
Emotion-focused coping	47.667	54.000	**-2.272**	.028
Avoidance coping	41.848	51.538	**-3.080**	.003
Psychological Well-Being Self-acceptance	60.060	51.154	**4.211**	.0001
Positive Relations with others	62.606	61.692	0.324	.747
Autonomy	60.030	56.308	1.303	.235
Environmental Mastery	62.818	50.769	**7.348**	.0001
Purpose in Life	61.333	60.077	0.569	.623
Personal Growth	67.333	55.154	**6.702**	.0001
Cumulative level of Psychological Well-being	374.181	335.154	**6.78**	.0001
SAQ *Achievement* Success expectations	17.545	11.308	**8.870**	.0001
Task-irrelevant behavior	9.909	14.923	**-8.990**	.0001
Seeking social support	16.091	16.077	0.012	0.99
Reflective thinking	15.576	19.462	**-4.236**	0.0001
Master-orientation	20.879	14.077	**8.170**	0.0001
Affiliative Success expectations	12.333	9.538	**4.440**	0.0001
Pessimism	9.636	12.308	**-5.455**	0.0001
Avoidance	14.242	20.615	**-6.189**	0.0001
Task-irrelevant behavior	14.788	21.538	**-6.427**	0.0001
Master-orientation	24.485	19.385	**3.382**	0.00152

There are also significant differences on the three basic strategies and attributions the participants are governed with in their life, as well as on the measures of psychological well-being: ecological mastery; personality growth; self-acceptance and the integrated Score of psychological well-being.

Their characteristic features assessed with the help of The Strategy and attribution Questionnaire differ on all the ten scales, except one – "expecting support".

These empirical data convincingly confirm our hypothesis as to the psychometric properties of the information-processing technique, which can be used not only as patented (Arshava, I., Nosenko, E., Khizha, O., 2010) to assess stability to failure stress, but also to predict the agentic activity of the individual.

Conclusions and discussion

Since the empirical data presented in the paper illustrate statistically significant between – person differences in both: the measures of performance on the information-processing task and the relevant personality variables, characterizing the orientation of the individuals to achieving success, active coping with difficult situations, the avoidance of the task-irrelevant behavior, there are all the grounds to claim that the technique, designed for predicting stability to failure stress, can be also informative as a measure of the *agentic activity*. The conclusion is based not only on the statistically significant differences registered in the stable personality traits (extraversion, conscientiousness, openness to a new experience and neuroticism), but

also on the strategies and attributions, the participants of different clusters habitually resort to as well as the differences in the levels of psychological well-being attempt.

The prospects of farther research in this direction we foresee in testing the technique of the implicit personality diagnostics on the participants who achieved different levels of success in the real-life settings.

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