

Using neural networks in building a psychological typology

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Abstract

The results of the relationship between psychological signs and the assessment of their significance in the situation of student adaptation to new socio-cultural conditions using the model of the neural network of ART 2 are presented. The external and internal factors that influence the adaptation of students to the new sociocultural environment are determined. The structure of the neural network model and its learning algorithm are developed. The standardization of scales made it easier to process the results. Using the software product of ART 2-self-regulation, a model of neural networks was created on the factors of adaptation of students to the training group and educational activities. On the basis of the peak indicators of the neural network, four clusters were identified that allow students to conduct a typology of regulatory and personal indicators of adaptation processes. Cross-cultural characteristics of representatives of each cluster are established. Thus, the "Initiative" cluster included indicators with peak values: "entry into social contact" (0,253), "flexibility" (0,224), "seeking social support" (0,213), "aggressive actions" (0,157), "modeling" (0,106). The main group of students demonstrating the patterns of adaptive behavior are students from Tajikistan. In the cluster "Inert" included indicators: "assertive actions" (0,264), "cautious actions" (0,190), "programming" (0,184), "avoidance" (0,183), "indirect actions" (0,158). The peak values of the "Stereotyped" cluster received scales: "impulsive actions" (0,260), "faults" (0,168), "antisocial actions" (0,166), "perceived hostility" (0,152), "evaluation of results" (0,130). The cluster of the model, called "Closed", combined indicators with peak values: "total level of acculturation stress" (0,169), "perceived discrimination" (0,127), "cultural shock" (0,161) "nonspecific problems" (0,145), "separation" (0,172). The prospects of using an artificial neural network in

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In: Marco Schaerf, Massimo Mecella, Drozdova Viktoria Igorevna, Kalmykov Igor Anatolievich (eds.): Proceedings of REMS 2018 – Russian Federation & Europe Multidisciplinary Symposium on Computer Science and ICT, Stavropol – Dombay, Russia, 15–20 October 2018, published at <http://ceur-ws.org>

interdisciplinary projects are shown.

1 Introduction

Intellectual data analysis with the use of neural networks has recently been increasingly used in psychological research, since it helps successfully solve complex problems with a large number of variables and data. Neural networks of the adaptive resonant theory (ART) reveal new input information and, to a certain extent, solve the contradictory problems of sensitivity (plasticity) and the preservation of the previously obtained information (stability). The choice of the task solved with the help of a neural network is determined by the way the network works and the way it is trained. At work, the neural network takes the values of the input variables and outputs the value of the winner's cluster. Thus, the network can be used in a situation where there is a certain array of known information, and it is necessary to obtain from it some information that is not yet known.

The neural network is used when the exact type of connections between the input data is unknown, - if possible, a relationship between the input data is linearly constructed, then the connection could be modeled directly without using the art neural network model. Another important feature of neural networks is that the dependence between input and output is in the process of learning the network. Two types of algorithms are used for training neural networks (different types of networks use different types of training): managed ("training with a teacher") and not managed ("without a teacher").

Despite the existence of a relatively large number of variants of the architectures of artificial neural networks of adaptive resonance, there are two main ones: ART-1 (for ART, AdaptiveResonanceTheory) for clustering, storage and identification of images in the form of binary signals; ART-2 - for clustering, storage and identification of images presented in the form of binary signals, and in the form of analog signals, including using both types of signals in one structure.

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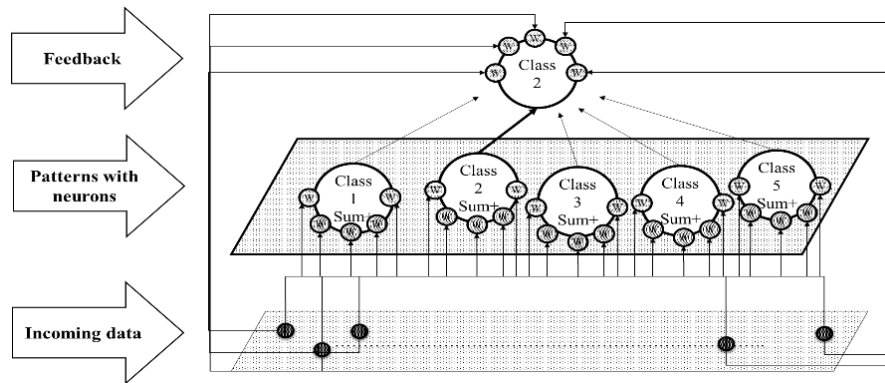


Figure 1: . Scheme of neural network ART 2

In our study, for computer processing of psychodiagnostic data, analysis of interrelations between psychological signs and evaluation of their significance, we used the model of neural network ART 2 1.

1.1 The purpose of the research

The purpose of this work is the development of a neural network model capable of functionally describing typologies of students on regulatory and personal indicators of adaptation to a new socio-cultural environment. To achieve this goal, it is necessary to solve the following tasks:

-to analyze the process of adaptation of university students in the context of adaptation to training activities

and to the training group;

- Identify external and internal factors that affect the adaptation of students to a new sociocultural environment;
- choose the methods that determine the regulatory and personal characteristics of students;
- to develop the structure of the neural network model and the algorithm of its training;
- to train an artificial neural network;
- identify the patterns between the weights of the neural network and the -indicators of student adaptation;
- identify the types of adaptation of students on regulatory and personal indicators, taking into account cross-cultural characteristics.

1.2 Research Hypothesis

The research hypothesis is based on the assumption that an artificial neural network trained without a teacher is able to detect patterns in the training sample and to cluster the input sequence; Artificial neural network type ART-2 uses the distance between the input vectors to separate them into different clusters.

The choice of this structure is argued by its simplicity in the analysis of the already trained artificial neural network ART-2.

So, since this artificial neural network consists of two layers (input and output), as well as weights affecting each parameter of the input vector. Having quantitative indicators of weights of concrete input values it is possible to calculate values that influence the forecasting of respondents' behavior in the context of psychological research. The empirical sample of the study included 233 students from North-Caucasian Federal University (CKFU) aged 18 to 25 from Uzbekistan (U) (65 people), Tajikistan (T) (22 people), South Africa (South Africa) (26 people), Iraq (I) (15 people), Angola (A) (24 people), nonresident students from Russia (RF) (81 people).

1.3 Methodology of research

Methods of research. A number of psychological methods were selected: the questionnaire "Style of self-regulation of behavior" (SMPM) [Mor04]; five factorial personality questionnaire (LPO) [Rem11]; method of diagnosis of motivation (MDM) educational activity of an individual in adolescence [Sol07]; the scale of acculturation stress (AS) [San94]; a questionnaire for the measurement of an acculturation unit, developed (adapted) by the method of J. Berry (AU)[San94]; a questionnaire on the identification of preferred strategies for overcoming stressful situations (SACS) (S. Hobfoll) allows to analyze models of overcoming behavior [Vod03]; a methodology for studying the adaptation of students (MIAS) in the university [Dubovitskaya TD, Krylova A.V. 2010].

The processing of data obtained using a package of psychological techniques, occurred in several stages. At the first stage, the data was standardized, each scale was assigned a sequence number to facilitate processing and clarity of the results obtained. At the second stage, the obtained data were processed using the computer program "ART-2 self-regulation", which allowed to train the artificial neural network ART-2 for constructing the model of adaptation of students to higher education.**fig2.eps**

1.4 Research results

In the model obtained, four clusters were identified, which allow us to determine the types of students according to the regulatory and personal indicators of the adaptation processes. We considered only peak values of the neural network as the most significant in each cluster.

The first cluster was named "Initiative", its peak values are: "entry into social contact" SACS (0,253), "flexibility" JPKF (0,224), "search for social support" SACS (0,213), "aggressive actions" SACS (0,157), "Modeling" of the JPKF (0.106). Respondents of this type are active for inclusion in the student group, initiative in communicating and developing techniques for adapting to learning activities in the new environment. Differences in the level of adaptation of respondents are explained by the distance between the student's native culture and the host culture (Table 1).

The peak values of the second, "inert" cluster are: "assertive actions" SACS (0.264), "cautious actions" SACS (0.190), "programming" SMF (0.184), "avoiding" SACS (0.183), "indirect actions" SACS (0.158). Respondents

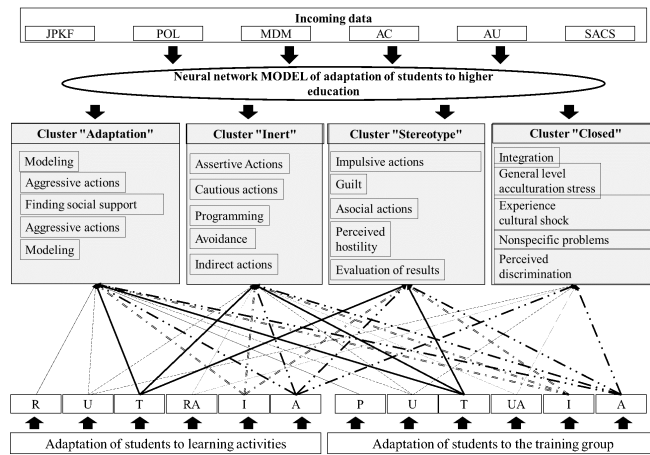


Figure 2: . Scheme of neural network ART 2

Table 1: The level of adaptation of students in the "Initiative" cluster to university education

1 cluster	By the study group			To learning activity		
	High	Medium	Low	High	Medium	Low
Russia	49,4	38,3	12,3	51,9	40,7	7,4
Uzbekistan	1,5	4,6	0,0	3,1	3,1	
Tajikistan		4,5	9,1		9,1	4,5
South Africa						
Iraq		6,7	6,7		6,7	6,7
Angola			8,3	8,3		

of this type tend to look at the environment for a long time, carefully build the program of behavior, focusing on their own interests. In this cluster, the proportion of adapted students is much higher (Table 2).

Table 2: The level of adaptation of students in the "Initiative" cluster to university education

2 cluster	By the study group			To learning activity		
	High	Medium	Low	High	Medium	Low
Russia						
Uzbekistan	24,6	27,7	13,8	20,0	33,8	12,3
Tajikistan 18,2	27,3	18,2	9,1	40,9	13,6	
South Africa 15,4	57,7	23,1	42,3	30,8	23,1	
Iraq		40,0	20,0	6,7	46,7	6,7
Angola 8,3	41,7	33,3	8,3	50,0	25,0	

The peak values of the third, "Stereotyped" cluster are: "impulsive actions" SACS (0,260), "fault" AU (0,168), "antisocial actions" SACS (0,166), "perceived hostility" AU (0,152), "evaluation of results" JPKF (0,130). Respondents of this type are suspicious of others, critically assess the requirements of the new environment. This adaptation strategy is not effective (Table 3).

The peak values of the Closed Cluster are: "the general level of acculturation stress" AU (0.169), "perceived discrimination" AC (0.127), "cultural shock" AU (0.161) "nonspecific problems" AS (0.145), AS "separation" (0.172). Respondents of this type experience the greatest problems with adaptation. Being determined to interact with the host culture, they painfully experience the difference between the environment and the familiar

Table 3: The level of adaptation of students entering the "Stereotyped" cluster to university education

2 cluster	By the study group			To learning activity		
	High	Medium	Low	High	Medium	Low
Russia						
Uzbekistan						
Tajikistan		9,1	13,6	4,5	9,1	9,1
South Africa						
Iraq		6,7	13,3		13,3	6,7
Angola		4,2	4,2		4,2	4,2

characteristics of the cultural environment (Table 4).//

Table 4: The level of adaptation of students entering the Closed Cluster to the learning environment

2 cluster	By the study group			To learning activity		
	High	Medium	Low	High	Medium	Low
Russia						
Uzbekistan	7,7	12,3	7,7	4,6	20,0	3,1
Tajikistan						
South Africa		3,8		3,8		
Iraq		6,7			6,7	
Angola						

1.5 Conclusion

The use of an artificial neural network in the processing of data sets of psychological research makes it possible to construct predictions of the behavior of respondents in the conditions under study. The use of artificial neural network type ART-2 in the course of studying the adaptation of students to the new learning conditions made it possible to identify 4 regulatory-personal types, which confirms the prospects of using an artificial neural network in interdisciplinary projects.

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