

## The Reciprocal Organization of Constructive Activity in Drug Addiction

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### ABSTRACT

The urgency of the problem stated in the article is caused by the fact that modern scientific studies show that sustainable neuro-associative connections with the object of addiction arise at chemical addiction. The aim of this study is to examine the features of the reciprocal organization of constructive activities in drug addiction. Study of the constructive activity of patients with drug addiction in comparison with the group in norm was carried out by using the experimental method. The study found a decrease of constructive activity in drug addiction by the characteristics of performance pace and accuracy, regulated by reciprocal and auditory-motor coordination, which, in turn, are also significantly reduced. Reciprocal organization in drug addiction is characterized by impaired proprioceptive kinesthetic afferentation of motor act at safety of outer space organization of movements, lack of differentiation and low handling of movements, movement program disorders, as well as the replacement of the right movements by motor patterns and stereotypes. The obtained results are experimental psychological argument for the need to introduce neuropsychological block in the system of psychotherapeutic impact, which includes the tasks aimed at increasing reciprocal organizations to improve the general level of constructive activity in order to create alternative to the stereotyped models of mental activity and patterns of behavior.

### KEYWORDS

Constructive activity, reciprocal organization, reciprocal coordination, profile of lateral brain organization.

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## Introduction

Multiple-date research findings prove that chemical addiction causes stable neuro-associative relations with the object of addiction (Anokhina, 2013; Anokhina et al., 2000; Morozova, et al., 2015; Nikishina & Zapesotskaya, 2010; Nikishina, et al., 2015; Beck et al., 2001; Akhmetzyanova, 2015). Reduced constructive activity in addiction stereotypes behavior in general, and particularly in relation to the object of addiction. On the one hand, physiological mechanisms activate association with the object (activate and maintain the craving). On the other hand, stereotyped activity supports sustainable patterns of behavior in relation to the object of addiction.

Neurophysiological activity at the level of the parietal association cortex, which is implemented in stereotyped perceptual images of the object of addiction, as well as the activity of the frontal (prefrontal) association cortex acts as a morphological-functional basis for the process of stereotyping behavior at chemical addiction, which is manifested in a general decline in voluntary regulation and motor stereotyping.

Asking the question about what neuropsychological mechanisms stereotyped behavior is supported by in drug addiction, it has been suggested that in addiction stereotyped behavior is a manifestation of the reciprocal organization of constructive activity violation.

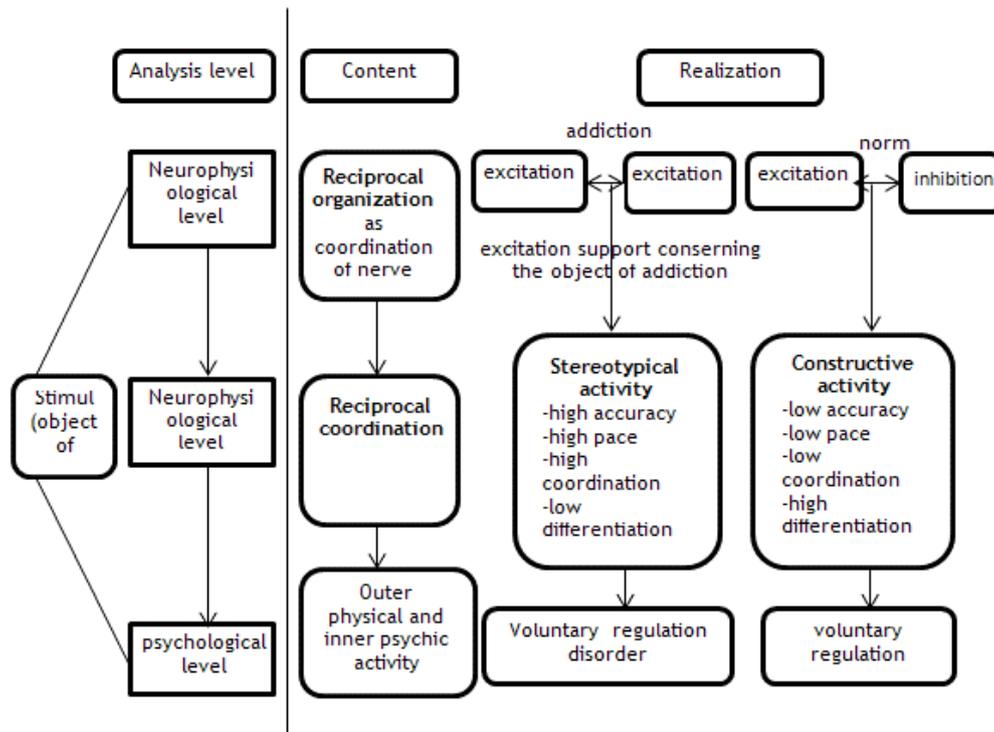
Reciprocal organization is determined by the coordinated functioning of the nerve centers of functional systems in which the excitation of the nerve centers of one system causes inhibition of the nerve centers of the antagonistic system. Reciprocal organization discloses the contents of one of the aspects of coordination activity of the central nervous system.

Coordination activity of the central nervous system as a whole is coherent and subordinated activity of the nerve centers, aimed at achieving the desired result. Three basic principles are laid down in the basis of the coordination activity: the principle of a common target path proposed by Sherrington; the principle of the beaten path; and the principle of a dominant by A.A. Ukhtomsky (2002).

In accordance with the "principle of the beaten path" (Karter, 2015; Frith, 2016) in addiction there appear pathological associative systems, where the impulse between neurons is conducted faster by pathologically predetermined path and initiated influence of stimulus - the object of addiction. This leads to the fact that an object of addiction without differentiation of external conditions.

At drug addiction pathological established associative action program leads to the blockage of new or invariant action programs formation. As a result the constructive activity is built on the "roundabout" way - by activation of brain structures, defined by the pathological association program, which organizes activities with respect to any objects as to an object of addiction, which leads to the stereotyped action.

The research of reciprocal organization of the constructive activity in drug addiction is conceptualized at the three levels of analysis: neurophysiological, neuropsychological and psychological (Figure 1).



**Figure 1.** The research model of reciprocal organization of constructive activity in drug addiction.

At the neurophysiological level reciprocal organization involves the simultaneous excitation of one of the nerve centers while inhibiting the others – opposite ones; at drug addiction reciprocal organization does not slow down the processes of the nerve centers excitation, which in turn leads to irregular actions performance and to their reduced control and coordination.

At the neuropsychological level the movement reciprocal coordination functioning is substantially provided by hemispheric interaction mainly at the level of transcallosal links (front and middle parts of the corpus callosum). The formation of the psychomotor reactions and their binding is provided mainly by prefrontal brain regions (the premotor areas as well as prefrontal ones). Functioning violation at the level of transcallosal links is manifested in general dis-coordination.

At the pathological excitation of the nerve centers to the stimulus impact in drug addiction there occurs peculiar transformation of functional connections between the frontal (mostly prefrontal) regions of the brain and the anterior corpus callosum, which is manifested in the stereotyping of individual psychomotor reactions, and in reducing the constructive activity in general. Taking into consideration that the structural activity involves transformation of the current psychomotor programs in accordance with the newly emerging conditions, stereotyped behavior in drug addiction eliminates the process of transformation due to the rigidity of functional links at the level of the frontal cerebral and the anterior corpus callosum.

Rigid links of the prefrontal associative cortex with other associative areas manifests itself in violation of the formation of constructive activity organization and in the emergence of a new action program. Activation is carried out by the already existing finished (stereotype) program of actions.

At the psychological level in drug addiction, individual behavior is directed at an active search for the object of addiction; it is characterized by stereotyping without differentiation of conditions. At the same time establishing new relations in reality at the expense of constructive activity hinders the formation of various forms and variants of behavior.

The aim of the research is to study the characteristics of the reciprocal organization of constructive activity in drug dependence.

### Materials and Methods

Conformity criteria and conditions of study. The total sample number was 107 persons (males), average age was  $29,4 \pm 5,8$  years (55 Russian-speaking persons, 52 English-speaking persons). Experimental and empirical study was carried out on the basis of Mental Hospital «Veresies Clinic» (Larnaca, Cyprus) as well as in the Kursk Regional Drug Addiction Clinic, under the terms of informed consent. The experimental group consisted of 57 testee (30 Russian-speaking and 27 English speaking) who were treated in the hospital with the F19 diagnosis - "Mental and behavioral disorders due to the simultaneous use of several narcotic drugs and the use of other psychoactive substances" (ICD-10).

The duration of drug use was at least 5 years. Patients' examination was carried out after the reduction of acute intoxication state (on the third-fifth day). The control group consisted of 50 testee (25 Russian-speaking and 25 English-speaking) who had baseline medical examination procedure.

The description of psychological intervention. The standard examination procedure included a clinical interview with the patient, consultation with a physician-expert in narcology, which were held in the office of a clinical psychologist in individual form. The duration of a patient's examination was 45-60 minutes. Instructing the testee was carried out in two languages (English or Russian, depending on the testee's knowledge) through a visual presentation of the written instructions.

The research results. The main focus of examination of patients with drug addiction was to study peculiarities of reciprocal organization of constructive activity: an experimental study of the constructive activity features, the study of reciprocal coordination features in patients with drug addiction, taking into account the profile of the lateral organization.

Methods of measuring outcomes. The study of the constructive activity of patients with drug addiction compared with a group of standards was carried out by using the experimental method (Table 1).

**Table 1.** The procedure of experimental research of constructive activity.

Equipment and materials	Experiment procedure	Diagnosed indicators
- plastic ring 10 cm in diameter; - red rope, 15 cm	The testee is offered to fix a red tape and a blue tape on the ring. Next, they had to wrap the red	t1- time of the task performance with the leading hand;

long, with double-sided tape at the end; - blue rope, 15 cm long, with double-sided tape at the end	rope 15 times around the ring with the left hand (if the left is leading - clockwise; if the right is leading - counter clockwise). They also had to wrap the blue rope 15 times around the ring with the right hand (if the right is leading - counter clockwise; if the left is leading - clockwise) At the end of the experiment the patient had to tie both ends of the ropes together.	t2- time of the task performance with the non-leading hand; ttot.- total time; O1- the number of mistakes when doing the task with the leading hand; O2- the number of mistakes when doing the task with the non-leading hand
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Profiling lateral brain organization of patients with drug addiction was carried out using dichotic audition method (determination of sensory asymmetry) and functional neuropsychological samples (determination of motor asymmetry), shown in Table 2.

**Table 2.** Neuropsychological samples to determine the profile of the lateral brain organization.

Profile parameters of the lateral brain organization	Procedure
Leading hand	Interlocking fingers (leading is the hand which thumb finger is atop); crossing arms on the chest or the "posture of Napoleon" (the leading is the hand, which is directed to the forearm of the other hand and is on top of it, while another hand is under the leading hand's forearm), applauding (when applauding the leading hand is more active and mobile while clapping on the palm of the non-leading hand).
Leading ear	Dichotic audition method. The patient was offered simultaneously two sets of verbal stimuli through headphones by separate channels. Leading was the side at which the productivity coefficient index was higher.

According to classification of the lateral brain organization profiles, the test group with the right hemispheric profile of the lateral brain organization (the left-handed) included testee who in the performance of tests on the study of the motor asymmetry in all indicators have the leading left hand; in performing the tests for the study of sensory (auditory) asymmetry leading is the left or the right ear. The group of testee with the left-hemispheric profile of the lateral brain organization (the right-handed) included testee who in the performance of tests on the study of the motor asymmetry in all indicators have leading right hand; in performing the tests for the study of sensory (auditory) asymmetry leading can be both left and right ear

The study of the reciprocal coordination features in patients with drug addiction was carried out using a set of functional neuropsychological tests of studies of the targeted motor functions (praxis), forming a constructive activity. Neuropsychological tests were presented in the following sequence: a test of counting fingers, a test of "the fist-the sharp of the hand-the palm", a test of the finger posture transfer by visual sample, a test of the finger postures transfer by a tactile model, a test of reciprocal tapping, the Hed test, a graphic test, a test of

auditory-motor coordination, a test of reciprocal coordination.

The performance of neuropsychological tests was carried out first with the leading hand, then with the non-leading hand. Quantitative assessment of the neuropsychological tests performance was carried out by four parameters (accuracy of performance, the pace of performance, co-ordination of movements at the test performance, differentiated movements), each of which was assigned to the corresponding point on the scale proposed by L.I. Wasserman (1997): 0 points (no errors or "non-specific" errors for a given test, typical of healthy testee as well, such as the spelling errors when writing and others.); 1 point (feebly-marked disorders, with a number of minor errors corrected by the testee himself practically without participation of the experimenter, the lower boundary of standard); 2 points (moderate violations of higher mental functions; the testee is able to perform the task after several attempts, with detailed prompts and suggestive questions); 3 points (serious disorders of higher mental functions; the task is impossible to perform even after multiple detailed explanations on the part of the experimenter).

**Statistical analysis.** Statistical analysis was performed using Statistika 8.0 software package. The quantitative data analysis was performed using nonparametric Mann-Whitney U-criterion, Spearman r-criterion of rank correlation, as well as the procedure of the factor analysis with varymax-rotation. Quantitative results are presented as the average parameters. The differences were defined as statistically significant at  $p < 0.05$ .

## Results

Presentation of the experimental and empirical research results was carried out in accordance with the objectives (Table 3).

**Table 3.** Organization of stages of the experimental empirical research of reciprocal organization of constructive activity in drug addiction

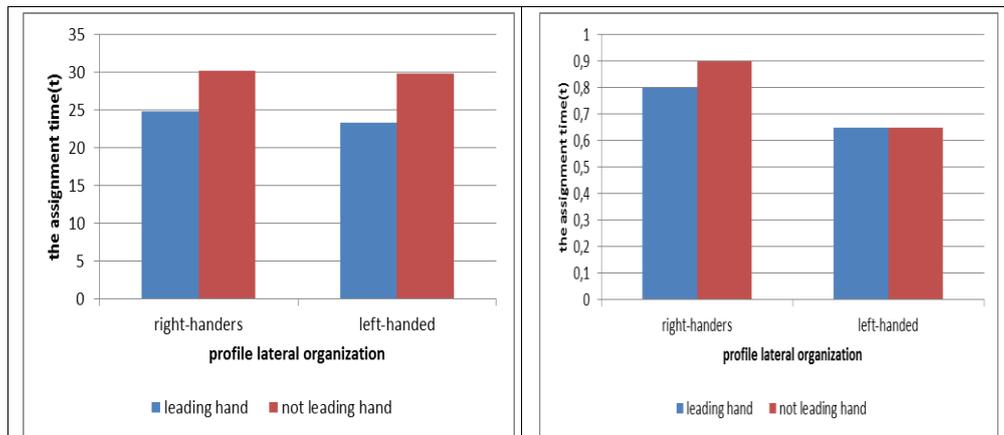
Parameters	1 stage	2 stage	3 stage
Objective	The study of the constructive activity of patients with drug addiction in comparison with the norm group.	The study of the reciprocal coordination of patients with drug addiction, taking into account the profile of the lateral brain organization	The study of the structure of reciprocal organization of constructive activity in patients with drug addiction considering the profile of the lateral brain organization.
Groups	The experimental group consisted of 57 people with drug addiction; the control group consisted of 50 people with no addiction.	The experimental group (E) included 24 patients with drug addiction of the right-hand profile of the lateral brain organization (leading left hand). The control group (K) included 33 patients with drug addiction of the left-hand profile of the lateral brain organization (leading right hand).	
Research methods	Experimental method of constructive activity	Empirical methods of the lateral brain	Correlation analysis using Spearman r-

	research. Statistical methods of data processing.	organization profile research; a set of the functional neuro-psychological tests of targeted motor functions (praxis) research.	criterion of rank correlation ( $p < 0.05$ ) and factor analysis with varymax-rotation ( $p < 0.05$ ).
The studied parameters	Significance assessment of the differences ( $p < 0.05$ ) of accuracy indices (number of errors in the performance of experimental task) and pace (runtime of experimental task) of constructive activity using the Mann-Whitney U-criterion.	Significance assessment of the differences ( $p < 0.05$ ) of neuropsychological tests results (performance accuracy, performance pace, coordinated movements, differentiated movements) by patients with drug addiction with right and left hemispheric lateral brain organization profile, using the Mann-Whitney U-criterion.	Structure of the correlation profile of interconnections of constructive activity indicators (pace and accuracy) and neuropsychological functional tests of motor functions study; determining factor structure of reciprocal organization of constructive activity in patients with drug addiction with the right and left hemispheric lateral brain organization profile.

The experimental study of constructive activity in patients with drug addiction revealed statistically significant overall reduction in constructive activity both in pace ( $p = 0.07$ ) and accuracy ( $p = 0.19$ ), which is manifested in an increase in the overall duration of the experimental task performance and significantly more mistakes in comparison with the standard group.

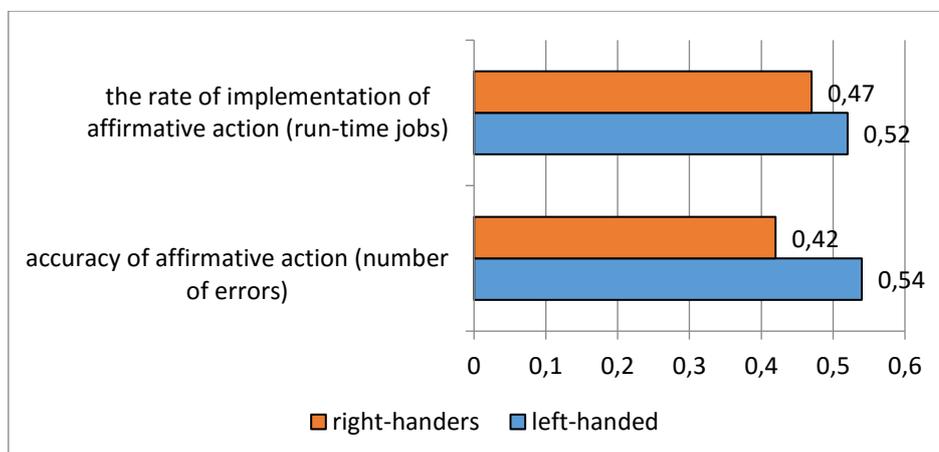
Determining the specific features of constructive activity in patients with drug addiction, with account of the lateral brain organization profile found that the in right hemispheric profile the lateral brain organization during the task performance ( $p = 0.028 *$ ) and the number of mistakes ( $p = 0.014 *$ ) was significantly higher than in the left hemispheric lateral organization profile (Fig. 1).

Time of experiment	Number of mistakes
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**Figure 1.** Histograms of the average performance time values and a number of mistakes in experimental constructive activity research with the account of the of the lateral brain organization profile in patients with drug addiction.

In order to build the profile of the constructive activity of patients with drug addiction, taking into account the profile of the lateral organization we carried out a correlation analysis using the Spearman  $r$ -criterion of rank correlation ( $p < 0.05$ ) between the performance run-time of a pilot task with leading hand and non-leading hand (the pace of constructive activity); as well as between performance mistakes, done by patients with drug addiction and the implementation of the experimental task with leading and non-leading hand (the accuracy of constructive activity). Correlation analysis results are presented in Fig. 2.

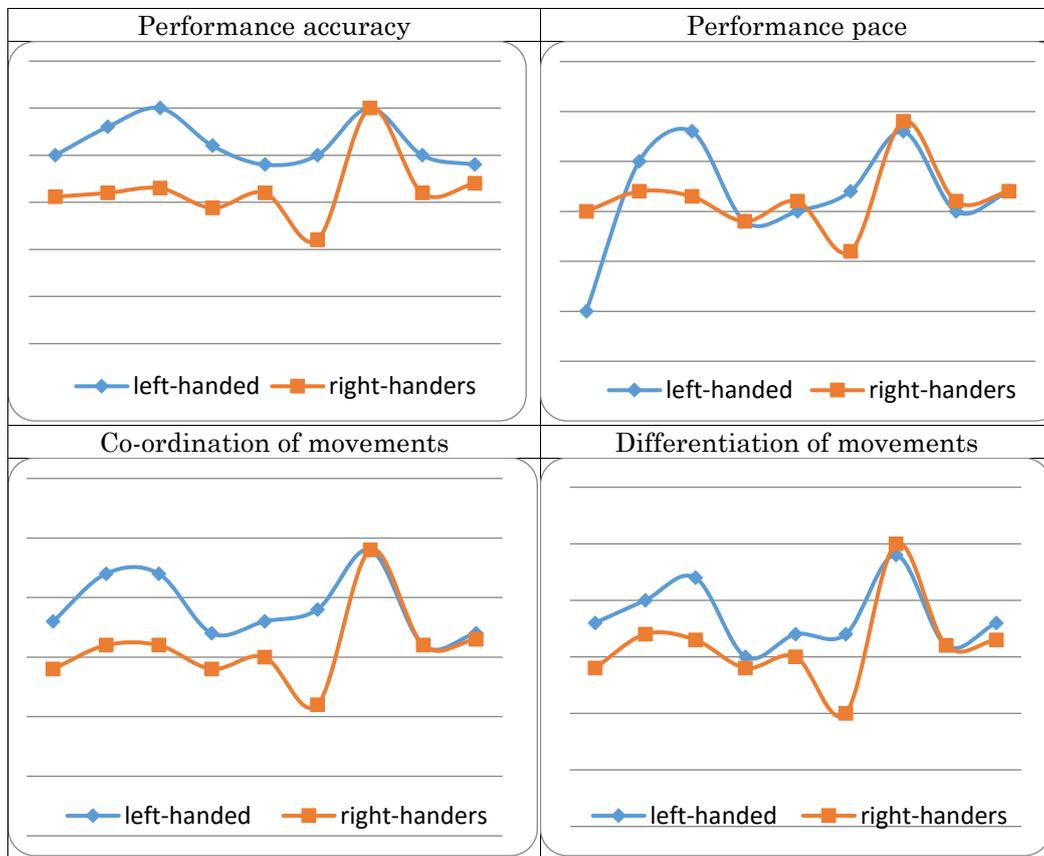


**Figure 2.** Correlation profile of pace and accuracy of constructive activity performance in patients with drug addiction, taking into account the profile of the lateral brain organization (Spearman  $r$ -criterion test,  $p < 0.05$ ).

The study of constructive activity in patients with drug addiction in view of the lateral organization profile revealed the following tendencies: at the right hemispheric lateral brain organization profile in patients with drug addiction (in left-handed patients) the pace and accuracy of constructive activity are

significantly reduced, compared to drug addicted patients with the left-hemispheric lateral organization profile (right-handed patients); consistency of constructive actions of both hands in patients with drug addiction, reflecting their reciprocal organization, in the right hemispheric lateral organization profile (in the left-handed) is higher than in the left hemisphere lateral organization profile (the right-handed).

The structure of neuropsychological diagnostics of reciprocal organization included the study tests of targeted motor functions: dynamic, kinesthetic and spatial praxis. The study of praxis functions in drug addiction revealed a significant breach in the performance of neuropsychological tests in drug addicted patients with the right hemispheric lateral organization profile (the left-handed) in performance accuracy and pace, as well as in the parameter of co-ordination and differentiation of movements (Fig. 3).



**Figure 3.** Graph of average values of neuropsychological tests of praxis functions research results performance in drug addiction, taking into account the lateral organization profile.

Drug addicted patients with the right hemispheric profile of lateral organization (left-handed) revealed a significant decrease in accuracy and pace of movements' performance as well as in co-ordination and differentiation of movements in comparison with patients with the left-hemispheric profile of lateral brain organization (right-handed). Actions of the patients with drug addiction are characterized by absence of differentiation and the low level of voluntary regulation. Violations of proprioceptive kinesthetic afferentation of

motor act at intact outer space organization of movements, regardless of the lateral brain organization profile in drug addiction were revealed.

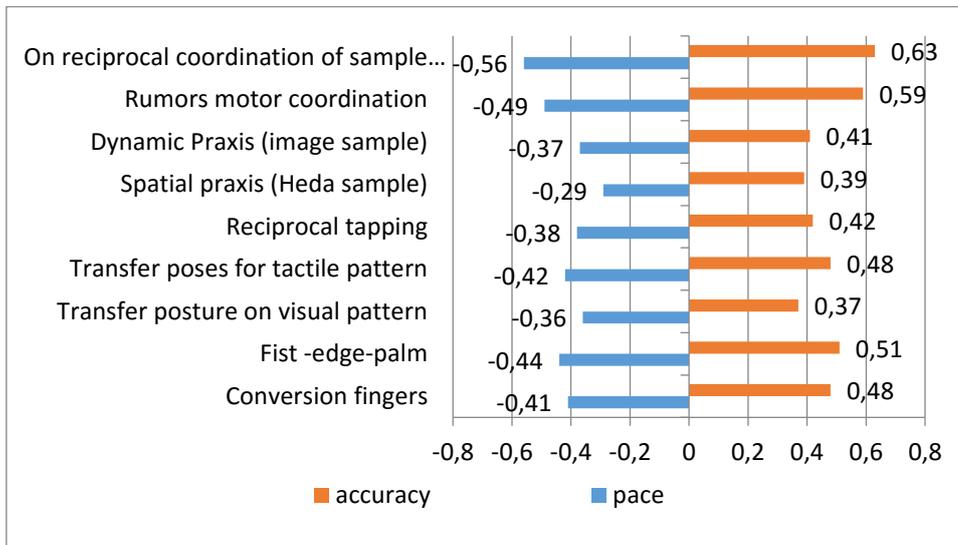
Performing the neuropsychological tests for the diagnosis of auditory motor coordination, involving the motor programs there was identified movements' disorders programming, the loss of conscious control over their implementation and replacement of the right motor movements patterns and stereotypes. In violation of voluntary regulation involuntary action regulation is also violated stereotypically. Violation of neuropsychological tests performance for the diagnosis of reciprocal movements' coordination by the parameters of pace, accuracy, differentiation and coordination of movements explains stereotyped actions in patients with drug addiction.

### Discussions

Defining mechanisms for reciprocal organization of constructive activity, with the account of the lateral organization profile of patients with drug addiction was carried out using two statistical procedures: correlation analysis using Spearman  $r$ - criterion of the rank correlation test ( $p < 0.05$ ) (to determine the system of relationship indicators of constructive activity and functional neuropsychological tests of praxis studies) and the factor analysis with varimax-rotation ( $p < 0.05$ ) (to determine the structure of the reciprocal organization of constructive activities).

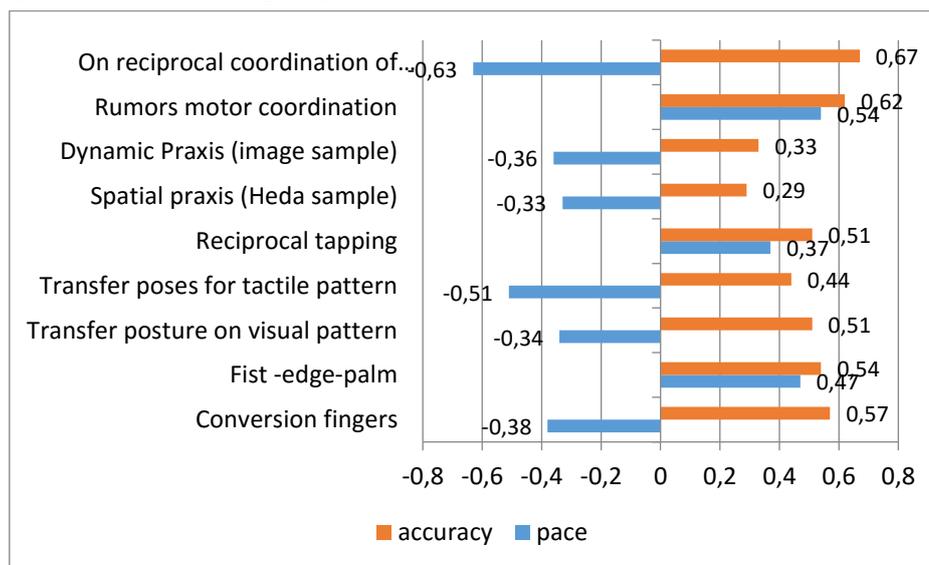
As a result of the correlation analysis of the constructive activity pace indicators (the total accumulated time of the experiment performance with both hands) with the results of implementation of neuropsychological tests of motor functions' study, as well as the productivity of constructive activity (the total number of errors when performing an experiment with both hands) with the results of implementation of neuropsychological tests of motor functions' study were built correlation profiles.

Correlation profile of drug addicted patients with left-hemispheric lateral brain organization profile (right-handed) is characterized by a predominance of statistically significant directly proportional relationship between indicators of productivity performance of neuropsychological tests and performance accuracy of constructive activity, characterized by the total number of mistakes made in the performance of experimental task. Assessing the relationship of neuropsychological tests' performance indicators and indicators of the constructive activity pace (total performance time for a pilot task with both hands) revealed statistically significant inversely proportional relationship, indicating a significant reduction in the pace of implementation of the experimental task, which manifests itself in an increase in the overall time of the job implementation with both hands, with increasing accuracy and efficiency of performing functional neuropsychological tests (Fig. 4).



**Figure 4.** Correlation profile of pace and accuracy of constructive activity indicators with the results of the implementation of neuropsychological studies tests of motor functions in drug addicted patients with the left-hemispheric lateral organization profile (the right-handed)

Assessment of the relationship of neuropsychological tests' performance indicators and indicators of the pilot task implementation pace (total performance time for a pilot task with both hands) revealed directly proportional statistically significant relationship between neuropsychological tests for complex motor programs implementation (auditory-motor coordination), reciprocal tapping and a test of "the fist-sharp of the hand-the palm". The indicators of the other neuropsychological tests implementation and a total running time of the pilot task identified inversely proportional statistically significant relationship (Fig. 5).



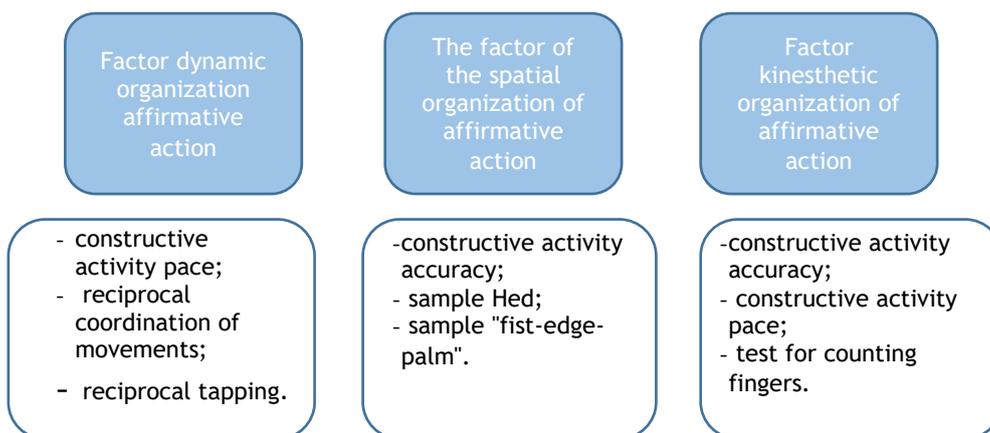
**Figure 5.** Correlation profiles of pace and accuracy of constructive activity indicators with the results of the implementation of neuropsychological studies tests of motor functions in drug addicted patients with the right -hemispheric lateral organization profile (the left -handed)

The obtained results indicate that the higher the accuracy and coordination of motor acts implementation with both hands in drug addicted patients with the right hemispheric lateral brain organization profile, the lower the performance of both the motor programs, and the individual motor acts and automatism.

As a result of factor analysis of constructive activity performance pace, productivity of constructive activities, and results of a neuropsychological study tests of motor functions in patients with drug addiction with both right hemispheric and left-hemispheric lateral organization profile three factors were identified: the factor of the dynamic organization of constructive actions (factor 1), the factor of the spatial organization of constructive actions (factor 2), the factor of kinesthetic organization of constructive actions (factor 3) (Fig. 6-7).

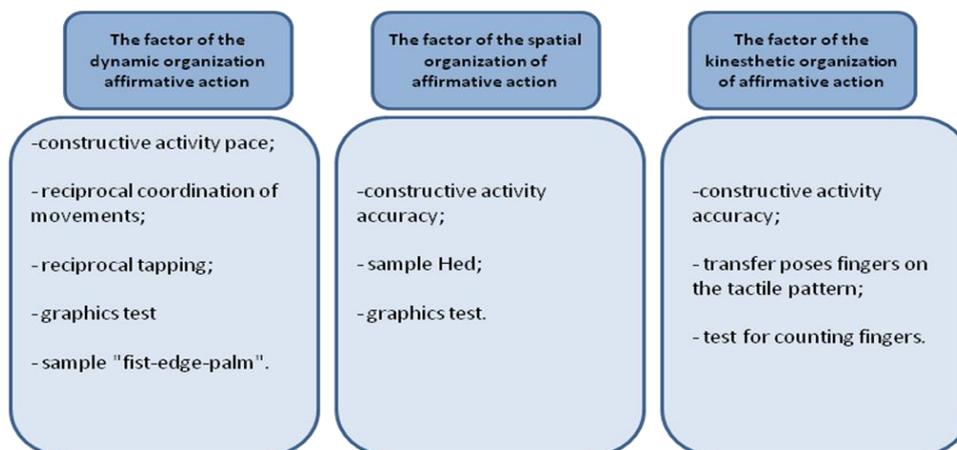
In the drug addicted patients with the left-hemispheric lateral organization profile (the right-handed), the first factor, which we defined as a factor of the dynamic organization of constructive actions, includes ( $F = 0.527$ ) indices of constructive activity pace, the result of the test for the reciprocal coordination of movements ( $F = 0.486$ ), the result of the neuropsychological test for reciprocal tapping ( $F = 0.631$ ).

The second factor, defined as the factor of spatial organization of constructive actions, includes indicators of accuracy of constructive activity ( $F = 0.429$ ), the results of neuropsychological Hed test performance ( $F = 0.518$ ), the results of neuropsychological test "the fist-the sharp of the hand-the palm» ( $F = 0.488$  ). The third factor, defined as the factor of kinesthetic organization of constructive action, is presented by accuracy indicators of constructive activity ( $F = 0.581$ ), the pace of constructive activity ( $F = 0.437$ ), the results of neuropsychological tests for counting fingers ( $F = 0.527$ ) (Fig. 6).



**Figure 6.** The factor structure of the reciprocal organization of constructive activity in drug addicted patients with the left-hemispheric lateral brain organization profile (the right-handed).

In the drug addicted patients with the right hemispheric lateral organization profile (the left-handed), the first factor, defined as the factor of the dynamic organization of constructive actions, includes the pace indicators of constructive activity ( $F = 0.386$ ), the result of the tests for the reciprocal coordination of movements ( $F = 0.592$ ), the result of the neuropsychological tests for reciprocal tapping ( $F = 0.489$ ), the result of a graphical test ( $F = 0.431$ ), the result of the neuropsychological tests "the fist-the sharp of the hand –the palm» ( $F = 0.509$ ). The second factor, defined as the factor of spatial organization of constructive actions includes the accuracy indicators of constructive activity ( $F = 0.618$ ), the results of the neuropsychological Hed tests ( $F = 0.427$ ), the graphic test results ( $F = 0.533$ ). The third factor, defined as the factor of kinesthetic organization of constructive actions, is presented by accuracy indicators of constructive activity ( $F = 0.614$ ), by the result of the neuropsychological tests for the transfer of fingers position by the tactile pattern ( $F = 0.549$ ), by the result of the neuropsychological test for counting fingers ( $F = 0.494$ ) (Fig. 7).



**Figure 7.** The factor structure of the reciprocal organization of constructive activity in drug addicted patients with the right -hemispheric lateral brain organization profile (the left -handed).

## Conclusion

The analysis of the reciprocal organization of constructive activity in patients with drug addiction experimentally proved the reduction of the constructive activity in the parameters of pace and accuracy in comparison with the norm (absence of addiction). The specific character of lateral organization of constructive activity drug addiction, which is characterized by a significant reduction of constructive activity in patients with drug addiction with the left-hemispheric lateral organization profile (the right-handed) in comparison with patients with the right hemispheric lateral organization profile (the left-handed) is revealed.

Reciprocal organization in drug addiction is characterized by impaired proprioceptive kinesthetic afferentation of the motor act with the intact outer

space organization of movements, absence of differentiation and low movements' handling, movements' programming disorders, as well as the replacement of the right movements by motor patterns and stereotypes. Significant decrease in the reciprocal organization in drug addicted patients with the left-hemispheric lateral organization profile (the right-handed) in comparison with patients with the right hemispheric lateral brain organization profile (the left-handed) is revealed.

The research revealed significant decrease of the reciprocal organization of constructive activity, supported by the factors of dynamic, spatial and kinesthetic organization of constructive actions in drug addiction. Moreover, in patients with the left-hemispheric lateral brain organization profile (the right-handed) these violations are expressed to a greater extent in comparison with patients with the right hemispheric lateral organization profile (the left-handed).

The constructive activity in drug addicted patients with the left-hemispheric lateral brain organization profile was significantly lower by the characteristics of pace and accuracy performance and is controlled by the reciprocal and auditory-motor coordination, which, in turn, are significantly reduced. At the behavioral level the results are interpreted as follows: during implementation of any act the processes of excitation and inhibition of the antagonistic nerve centers do not define a model of actions that form (organize) the program of activity.

The obtained results are experimental psychological argument for the need to introduce in the system of psychotherapeutic influence the neuropsychological block, which includes the tasks aimed at increasing reciprocal organization to improve the general level of constructive activity in order to create alternative stereotyped patterns of mental activity and behavioral patterns.

### **Recommendations**

The obtained results are experimental psychological argument for the need to introduce neuropsychological block in the system of psychotherapeutic impact, which includes the tasks aimed at increasing reciprocal organizations to improve the general level of constructive activity in order to create alternative to the stereotyped models of mental activity and patterns of behavior.

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### **Disclosure statement**

No potential conflict of interest was reported by the authors.

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