EFFECT OF EXTERNAL AND INTERNAL FACTORS ON DEPENDENCE OF THE ACTION OF PSYCHOSTIMULANTS ON LEARNING ABILITY

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According to data in the literature [1-6, 9, 10] administration of psychostimulants can increase or reduce the speed of learning or leave it unchanged. Differences regarding conclusions on the character of action of these drugs may depend on the effect of factors limiting the rate of formation of adaptive reflexes on it. The role of dosage of psychostimulants [8, 10] and of the type of emotional reaction in a stress situation [2] has not been demonstrated.

The aim of this investigation was to study the role of external (type, difficulty of behavioral tasks) and internal (level of investigative activity and type of emotional reaction) factors in the action of psychostimulants on the learning ability of animals.

EXPERMENTAL METHOD

Experiments were carried out on 253 noninbred albino rats. The learning procedure in a T maze consisted of the action of a conditioned stimulus for 5 sec, alternating with electrical stimulation of the animals' limbs until moving into the safe compartment. Indication (illumination) of the safe compartment was carried out in random order or stationarily. The learning criterion was a 70% level of performance of conditioned avoidance reactions (CAR). In a Dombrovska [7] maze the rats were taught beforehand to proceed from the start compartment to the safe (food-reinforced) area by any route (all four doors in each of the four partitions of the maze were open). Next, one door out of four was left open in each partition. The criterion of learning was performance of six successive correct responses. The route of the avoidance reaction was then changed another four times, and relearning carried out. Sydnocarb (10 mg/kg), amphetamine (0.5 mg/kg), caffeine (20 mg/kg), acephen (100 mg/kg), pyracetam (200 mg/kg), and euclidan (40 mg/kg) were injected intraperitoneally 20 min before training.

EXPERIMENTAL RESULTS

The rate of formation of CAR in a T maze depended on the difficulty of the task. If conditioning took place after consolidation of the avoidance skill, after 30 tests the number of conditioned responses was 16.2 ± 2.1. During simultaneous training in avoidance and escape, the same number of CAR appeared after 100 tests. The use of the latter model of learning revealed the stimulating effect of sydnocarb, amphetamine, and caffeine. The action of acephen was independent of this factor (Table 1).

During the operation of alternative choice the speed of learning also depended on the complexity of the situation. It was slower if the indicator of the safe compartment was changed randomly. Transformation of the situational stimulus into a conditioned stimulus in the more difficult task was facilitated by sydnocarb, amphetamine, and euclidan. Meanwhile caffeine, acephen, and pyracetam did not exhibit any positive effect (Table 1).

In an even more difficult task, when the animals learned the skill of multiple choice in a Dombrovska maze, the effect of the drugs on learning depended on the type of emotional response. In the case of active-defensive manifestations in response to electrical stimulation of the animals' limbs (group 1) the rats acquired the ability to perform multiple choice faultlessly more rapidly. Under these circumstances all drugs except pyracetam increased

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TABLE 1. Effect of Psychostimulants on Learning Ability of Rats in a T Maze (M ± m)

Substance	Dose, mg/kg	Type of task	Number of animals	Indicator of conditioning	
				number of conditioned responses	number of correct choices, %
Control		A	18	16,2±2,1	100
		B	8	16,9±3,9	100
Sydnocarb	10	A	6	19,2±2,7	165*
		B	6	30,1±6,3*	105
Amphetamine	0,5	A	6	17,1±2,5	191*
		B	6	34,6±8,1*	113
Caffeine	20	A	6	18,1±3,1	129
		B	6	24,8±3,6**	108
Acephen	100	A	6	11,5±3,1**	77
		B	6	10,6±3,5**	98
Pyracetam	200	A	6	21,4±4,1**	129
		B	—		
Euclidan	40	A	6	7,1±1,2*	148*
		B	—		

Legend. A) CAR formation in response to random presentation of indicator of safe compartment, B) during stationary presentation. *P < 0.05, **P < 0.1 compared with control.

TABLE 2. Effect of Psychostimulants on Formation of Combined Defensive Skill in Rats in Dombrovska Maze (M ± m)

Substance	Dose, mg/kg	Group of animals	Number of animals	Speed of learning (number of tests)		
				formation of first skill	relearning	
					2—3rd skill	4—5th skill
Control		1	18	24,5±3,5	23,5±3,2	11,6±2,9
		2	6	33±5,7	29,9±3,7	14,1±4,1
Sydnocarb	10	1	10	13,8±2,1*	15,6±2,7*	13,4±2,1
		2	6	17±2,3*	18,9±3,9*	10,6±3,4
Amphetamine	0,5	1	7	15±2*	15±4,1**	10,8±2,8
		2	6	16±6,7*	13,2±2,2*	12,1±2,1
Caffeine	20	1	6	14,8±2,8*	15,4±5,6**	7±16,9**
		2	6	26±7,3	16±4,1	7,4±6,6
Acephen	100	1	6	16,4±3,8*	20,8±3,7	10,2±4,1
		2	6	36,8±8,9	21,3±6,2	10±3,9
Pyracetam	200	1	6	21,8±3,6	15,8±4,1**	11,4±1,9
Euclidan	40	1	6	14,1±3,3*	13,5±2,9*	10±2,1

Legend. Group 1) Rats with active-defensive manifestations in stress situation, group 2) rats with passive-defensive manifestations. *,**) See Table 1.

learning ability. Meanwhile all drugs except acephen facilitated relearning in the second and third sessions. In the group of "passive" rats sydnocarb and amphetamine were effective (Table 2). Consequently, animals with dominance of behavioral inhibition exhibited low sensitivity to most psychostimulants in a stress situation.

The different levels of investigative and motor activity of the rats served as the basis for subdividing the animals into three groups: I) with a low level of activity, II) intermediate group, III) with a high level of activity. The time course of learning and relearning in rats of the different groups did not differ significantly. Sydnocarb and sydnophen equally increased learning ability in the first two groups. A tendency for the effects of amphetamine and caffeine to depend on the level of investigative activity was found experimentally (Table 3).

To sum up the results it can be concluded that the factor of task difficulty is directly reflected in the ability of the principal psychostimulants to increase learning ability. The type of task (attachment of conditioned-triggering or conditioned-situational significance to the stimuli) was less important. Pharmacologic facilitation of the stage of evalu-

TABLE 3. Effect of Psychostimulants on Formation of Food-Getting Skill in Rats in Dombrovska Maze (M ± m)

Substance	Dose, mg/kg	Group of animals	Number of animals	Speed of learning (number of tests)	
				formation of first skill	relearning, 2nd-5th skill
Control		I	10	28,5±6	43,7±5,9
		II	10	25,8±5,1	37,1±5,5
		III	10	23,4±3,6	36,4±4,6
Sydnocarb	10	I	6	13,8±4,4*	28,6±6,3*
		II	6	15,1±4,1*	26,1±7,1**
Sydnophen	10	I	6	12,9±3,7*	26,9±7,1*
		II	6	14,7±3,9*	25,6±6,2**
Amphetamine	0,5	I	6	19,7±2,6**	31,4±5,1**
		II	6	21,2±2,5	30,6±6,5
Caffeine	20	I	6	18,6±3,8**	32,2±2,9
		II	6	19,3±3,4	32,3±1,4

Legend. Group I) low level of investigative and motor activity, II) intermediate group, III) high level of investigative activity in chamber with open doors. *,**) See Table 1.

ation of situational information and construction of motor programs depend to a greater degree on emotional factors than on investigative activity. The principles established in the action of these drugs must be taken into account when potential psychostimulants are screened.

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