SUMMATION EXPLOSIVENESS

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The problem of the "explosiveness" of nervous processes was first encountered in Pavlov's laboratory in connection with experimental production of abnormalities of higher nervous activity. When discussing pathological changes in the mobility of the process of stimulation, Pavlov [7] indicated two abnormal trends: pathological inertia and pathological lability. The latter state was defined as explosiveness, and was observed in situations of conflict [8], in starvation [1], and in castrated dogs [8]. The mechanism of this phenomena was explained as a disturbance of the equilibrium between excitation and inhibition.

Subsequently, P. S. Kupalov and his co-workers [4, 5, 6, 9] showed that explosiveness of nervous processes may also be observed in the activity of the cortical cells as a transient change in higher nervous activity in the course of the establishment of a balance between excitation and inhibition, not causing pathological disturbances.

In our studies of the limits of the process of inhibition, we observed the phenomenon of explosiveness of the nervous processes; from our point of view this phenomenon was characteristic of a preneurotic state of the animals.

EXPERIMENTAL METHOD

The investigation was carried out in a soundproof room, using the method of conditioned food-salivary reflexes. The secretion was recorded by means of a Ganicke-Kupalov hydropneumatic system. Each scale division corresponded to 0.01 ml of saliva. The unconditioned reinforcement was 20 g of powdered meat and biscuit mixed with water in the proportion of 1:1.

A system of conditioned reflexes was formed in the dogs, including a positive reflex to a note of 400 cps, and differentiation between this and a note of 200 cps. The intensity of the sound could be increased from 50 to 130 dB. Technical information regarding the apparatus we used is given in our earlier paper [2]. As a rule the stimuli were applied in a definite order at intervals of 5 min.

EXPERIMENTAL RESULTS

A gradual increase in the loudness of the inhibiting stimulus from 50 to 100 dB caused no appreciable changes in the higher nervous activity of the dogs [2, 3]. With a further increase in the loudness of the inhibitory stimulus (over 100 dB) a change was observed in the magnitude of the conditioned reflexes and explosiveness developed. The results of experiments on two dogs in which these changes were especially pronounced are described in the table.

It will be seen from the results of experiment No. 332 (the dog Romul) that the magnitude of the inhibitory conditioned reflex (which usually fluctuated between 0 and 21 scale divisions) was 123 scale divisions, which was much greater than the positive reflex, and the course of secretion was explosive in character. The "explosion" of secretion was followed by after-inhibition and refusal to eat. The subsequent application of an inhibitory note of intensity 120 dB, followed by one of 130 dB, caused a lasting disinhibition of differentiation from 14 to 33 divisions, but no manifestations of explosiveness were observed.

A similar picture was seen in the other dog (experiment No. 337, the dog Dzhek). In this case, however, both on the day of the experiment and subsequently, the positive conditioned reflexes decreased sharply, the motor restlessness increased, and the animals refused to eat. The onset of the symptoms gave evidence of impending neurotic changes in the higher nervous activity. However, after decreasing the loudness of the inhibitory note, the symptoms disappeared at once, and the dog's normal conditioned-reflex activity was restored.

In the experiments cited we observed an outburst of strong excitation during the action of a very loud inhibitory stimulus (over 100 dB). We called this phenomenon "summation explosiveness" by analogy with the similar outburst studied by P. S. Kupalov and N. A. Kostenetskaya [6] during a temporary weakening of the inhibitory process under the influence of strong excitation arising from the chemical analyzer. The term "summation" implies the combination of two effects: the effective stimulation resulting from the strong inhibitory conditioned stimulus, and the stimulation arising as a result of the particular functional state of the animal at the given moment.

Changes in the Conditioned-Reflex Activity of Dogs in Response to a Loud Inhibitory Stimulus (110-120 dB)

Conditioned Stimulus	Period when conditioned stimulus acted alone	Period of delay of conditioned reflexes (in sec)	Course of conditioned secretion in scale divisions (recorded every 5 sec)	Magnitude of conditioned reflex	Magnitude of unconditioned secretion in 1 min
	Experiment No. 332 (Dog Romul)				
Gurgling	15	2	8+20+20	48	410
Note + 400, 50	15	2	6+15+13	34	400
Light	15	1	15+20+15	50	400
Note −200, 120	15	3	2+3+118	123	–
Metronome	15	4	3+19+9	18	None
Gurgling	15	2	8+19+21	48	"
	Experiment No. 337 (Dog Dzhek)				
Metronome	20	–	0	0	240
Note + 450, 50	20	–	0	0	220
Light	20	–	0	0	230
Note −200, 110	20	3	5+45+65+70	185	–
Metronome	20	3	3+3+4+5	15	235
Light	20	3	2+12+20+6	40	230

Note. The plus sign denotes the positive value of the stimulus, the minus sign denotes its inhibitory value. The first number describing the note gives its frequency (in cps), the second its loudness (in decibels).

It is possible that in our case stimulation from the strong inhibitory stimulus was superimposed upon a definite functional state of the auditory inhibitory center. This put a considerable strain on the process of inhibition, with the result that the balance between excitation and inhibition was upset, as shown by the predominance of first one, then the other. The disturbance of equilibrium was expressed by the absence of effect or the greatly diminished effect of positive stimuli and the marked disinhibition during the action of inhibitory stimuli.

Our observations thus confirmed the presence of explosiveness in the activity of pathologically unchanged cortical cells, as discovered by P. S. Kupalov and co-workers. At the same time, in our opinion the explosiveness of nervous processes in association with a decrease in the positive conditioned reflexes may be a manifestation of a preneurotic state.

SUMMARY

Data presented in this work confirm P. S. Kupalov's observations on the presence of so-called "explosiveness" in the activity of pathologically unaffected cortical cells. At the same time it is pointed out that phenomena of "explosiveness" of the nervous processes with reduction of the positive conditioned reflexes may serve as a symptom of preneurotic state.

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