CHANGES IN HUMAN CONDITIONED REFLEXES INDUCED BY CARBON MONOXIDE AND BY VIBRATION

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Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 53, No. 1, pp. 45 - 47, January, 1962
Original article submitted January 21, 1961

External factors acting on a human being during labor are extremely varied in strength, in nature, and in their combinations. In many cases, under certain circumstances the body is exposed to the action of exceptional external stimuli, such as noise, vibration, poisonous substances,etc.

The object of our investigations was to determine the changes in the latent period of conditioned reflex responses in people receiving the widely different external stimuli of vibration and carbon monoxide. Our starting point was that there are general laws relating the response of the organism to stimuli of different kinds and different strengths, and their many aspects have been studied by I. P. Pavlov by the method of conditioned reflexes.

METHOD

Observations were made on 36 young people who were divided into four groups of nine subjects. In the first group, the conditioned reflexes developed were based on the unconditioned blink reflex. The conditioned stimuli were the tones from an audiooscillator, and the unconditioned stimulus was a jet of air directed onto the cornea. The response of winking was recorded on a special moving-ribbon mechanism.

In the second group, motor conditioned reflexes were developed with speech reinforcement applied by the method of A. G. Ivanov-Smolenskii. As a positive stimulus we used yellow and green lamps, while the negative stimulus was a red light. We measured the latent periods of the reflexes and their magnitude.

In subjects of the third group we measured the latent periods of the reflexes in response to sound and light signals during electrical stimulation of the skin of the forearm.

In subjects of the fourth group we measured to an accuracy of 0.01 second the time for the simple motor response to the appearance of a light signal without reinforcement with the unconditioned stimulus. For this purpose we used the apparatus for sensory motor reactions.

The reason for using several methods was, on the one hand, to determine the nature of the changes in the latent periods, and the magnitude of the conditioned reflexes developed on the basis of various unconditioned reflexes, and on the other to supplement and extend one method of investigation by another.

The subjects of all four were subjected to the action of quite different external factors. In the first case they were placed under conditions where they had to inhale air containing a high concentration of CO (up to 2.5 mg per liter) for 15 - 25 minutes, and in the second arrangement they were submitted to the action of vibration, when they received 15 - 18 jolts per minute giving acceleration up to 1.5 - 2 times that due to gravity.

RESULTS

While CO at a concentration of 0.6-0.83 mg/liter acted for 25 min, in eight subjects of the first group the changes were the same, and consisted of a marked "stabilization" of the latent periods of the conditioned reflexes. Table 1 shows the results of the most typical experiment, which illustrates this point.

As can be seen from Table 1, before the action of CO the latent periods of the conditioned reflexes lay between 0.45 and 0.91 second, but during its action they were stabilized at 0.6 second. These changes were also observed in subjects of the second group, but in relation to conditioned reflexes based on light stimulation.

In people of the third and fourth groups, in whom more stable motor responses were developed, as for example in a defensive reflex, with concentrations of CO up to 0.8 mg/liter there was no stabilization of conditioned reflex

activity. In these groups, the effects were produced only at CO concentrations of 1.2 mg/liter or above, a result which indicates the great stability of the simple reactions against harmful influences. Stabilization of the latent periods in subjects of the third and fourth groups through exposure to CO occurred only in half of the cases, and it was not well shown.

Thus of 36 subjects exposed to high concentrations of CO, in 23 there was a marked stabilization of the latent periods and magnitudes of the conditioned reflexes elaborated in response to light- and sound-conditioned stimuli.

Similar and very clear-cut effects also occurred in response to the entirely different harmful factor of vibration. Of the 36 subjects observed, stabilization of the latent periods immediately after the vibrations had been applied occurred in 26 of them. We here report the most typical results.

TABLE 1. Latent Periods of the Blink Conditioned Reflexes in Subject B before and during Exposure to 0.6-0.83 mg/liter CO. Conditioned stimulus —a 256 cycle tone

Before the action		During the action	
Sequential number of the conditioned stimulus	Latent period of the conditioned reflex (in seconds)	Sequential number of the conditioned stimulus	Latent period of the conditioned reflex (in seconds)
131	0.88	152	0.72
132	0.54	153	0.72
133	0.72	154	0.60
134	0.45	155	0.60
135	0.63	156	0.60
136	0.91	157	0.60
137	0.42	158	0.60
138	0.72	158	0.60
		159	0.60

TABLE 2. Variation of Latent Periods of Conditioned Motor Reflexes with Light Stimuli for Subject A before and after the Vibration Action (on 10th Day after Start of Conditioned Reflexes)

Conditioned stimulus (lighting of the lamp)	Latent periods (in seconds)	
	before the action	after the action
Red light	0.33	0.20
Green light	0.27	0.22
Green light	0.32	0.22
Red light	0.24	0.22
White light	0.18	0.23
Red light	0.16	0.24
Red light	0.24	0.22
Green light	0.32	0.22
White light	0.23	0.23
Green light	0.18	0.22
White light	0.28	0.22
Red light	0.26	0.20
White light	0.24	0.24
Red light	0.26	0.22
Green light	0.32	0.20

In subject A, for seven days measurements were made of the latent periods of the responses, and on the seventh day, they varied between 0.15 and 0.28 second. After being submitted to vibration treatment for six hours, the latent period stabilized at a value of 0.16 second.

Later, to complicate the task, conditioned reflex reactions were elaborated to the combined stimulus of lights presented successively as indicated in Table 2 (altogether there were 15 light signals made up of white, red, and green lights).

Despite the prolonged use of this sequence of stimulation, the latent period varied considerably. After the action of vibration, the variation was considerably reduced.

From Table 2 it can be seen that before the vibration, the latent periods of the response to various light stimuli varied from 0.16 to 0.32 second, but afterwards it was stabilized at 0.22 - 0.24 second.

We have shown experimentally that under the influence of two external factors, CO and vibration, which are different in nature, identical changes occur in the central nervous system, and in both cases the latent periods of the conditioned reflexes are stabilized. The mechanism is far from clear. There is no information which would lead us to infer that stabilization of the latent periods is brought about by the development of an internal inhibition, because the latent periods of the response to positive stimuli were not prolonged, but actually shortened. Also, it is quite impossible to explain the effect in terms of the theory of the dominant. Were a zone of the dominant to de-

velop in the cortex, it would then be expected that conditioned reflexes involving different receptor fields would exhibit the same latent periods. However, in this case, the latent periods of the responses to light and sound stimuli were stabilized at different values.

In our opinion, the stabilization of the latent period of a conditioned reflex should be regarded as a generalized reduction of the functional mobility of the cortical processes. As a result of the influence of a harmful agent, the nervous system can no longer vary the speed and magnitude of its response. Hence, from the experimental results we may conclude that not all parts of the cerebral cortex simultaneously undergo a reduction of the functional mobility of the nervous processes.

The stabilization of the latent periods affected primarily the conditioned reflexes based on the blinking unconditioned reflex. Evidently this reflex is built up on the basis of nervous elements which are more sensitive to the action of the harmful agent. The greatest stability was shown by the defensive reflexes.

SUMMARY

Observations were made on the conditioned reflex activity of 36 subjects during exposure to high CO concentrations and intense vibration. The result was a uniform stabilization of the latent period of the conditioned reflexes.

The condition induced is regarded as a special state of the cerebral cortex in which the functional mobility of nervous processes is reduced.

LITERATURE CITED

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