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Ultra-low doses of different biologically active substances regulate neuronal functional states

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An organism obtains environmental information by means of a system of senses. By definition, psychophysics studies interaction between objectively measurable physical processes and feelings experienced by the subject. Objective measurements of the activity of biological substances in relation to operating incentives show that it is considerably more sensitive than the subject is able to report. At ultra-low intensity, nonspecific properties of usual agents emerge. A typical feature of any biological system is the nonlinearity of response to an increasing influence – a so-called "dose–effect" curve. Recently, it has been shown that the dependence between the parameters of influence and the response can be bimodal: the effect increases as the influence reduces, then, in the process of further reduction of the acting substance, the response decreases, after that it is replaced by a dead zone, and later, as the intensity of influence keeps lowering, the response grows again. This relation has been proved valid for physical factors and chemical substances[1]. Our experiments were conducted on a semi-intact preparation of a mollusk Helix lucorum and isolated neurons of nervous system with the use of several biologically active substances: two kinds of synthetic antioxidant, GABA, ethanol, acetylcholine, serotonin, DSIP (delta-sleep inducing peptide), antibiotic ruboxil, nootropic GVS-111 and ethanol. The isolated neurons were placed into a special chamber. All the substances (0.35 ml) were introduced into the chamber in single dosing, mixed with normal saline in concentration 10^{-3}–10^{-27}M. The following characteristics were checked: the level of membrane resting potential (MP), the electroexcitable membrane and pacemaker mechanism, chemical sensitivity of somatic membrane loci to neurotransmitter acetylcholine (Ach). The results demonstrated that all the substances initiated the development of prolonged neurophysiological responses. Within the contact interval, the intensities of neuronal reactions do not depend on the concentration and type of substance. Our experiments within the concentration range of 10^{-3}M–10^{-27}M reveal multiple dependencies of a dose effect on various substances. Each dependency shows an individual form of neuronal response to a certain substance. It means that the results will vary depending on acting substances so far as the neural systems responding to this influence show a certain form of behavior.

The studies of the effect of ultra-low doses of chemical and physical factors on living substance illustrate the fundamental behavior-regulating role of agents that remain unnoticed by the subject (especially if the subject is human). In order to understand what regulates a person's behavior, we must expand the borders of psychophysical research beyond the limits of awareness.

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