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Jose Delgado's "Physical Control of the Mind"

Sensory Dependence of the Adult Mind

Even if reception of sensory information is accepted as totally essential for the onset and development of mental functions, it is more or less explicitly assumed that an adult has a well-established mental capacity which functions with relative independence of the environment. Individuality, initiative, and free will are expressed in the ability to accept or reject ideas and select behavioral responses. A man can isolate himself, meditate, and explore the depths of his own thoughts. To a great extent education, especially in Occidental cultures, is based on the belief that individual personality is a self-contained and relatively independent entity with its own destiny, well differentiated from the surroundings, and able to function by itself even when isolated from earth and traveling in an orbiting capsule.

A more detailed analysis of reality, however, shows that cerebral activity is essentially dependent on sensory inputs from the environment not only at birth but also throughout life. Normal mental functions cannot be preserved in the absence of a stream of information coming from the outside world. The mature brain, with all its wealth of past experience and acquired skills, is not capable of maintaining the thinking process or even normal awareness and reactivity in a vacuum of sensory deprivation: The individual mind is not self-sufficient.

Support for this statement derives from neurophysiological and psychological experimentation. In mammals, the central

organization of motor activity is localized in special regions of the cerebral cortex where muscles and ideokinetic formulas are represented. The motor pathways descend through the spinal cord and emerge through the ventral roots to form plexus and motor nerves. As should be expected, experimental destruction in animals or pathological damage in man of the ventral roots produces complete motor paralysis because the cerebral impulses cannot reach the muscle target. Considering the input side, we know that all sensory information from the periphery, including proprioceptive impulses from the muscles, is carried by the dorsal roots of the spinal cord. As anticipated, destruction of all dorsal roots produces a loss of sensation, but in addition, there is also a paralysis of the musculature as pronounced as when the motor roots are interrupted. These experiments show that in the absence of sensory information, motor activity is totally disrupted. The brain and motor pathways are not sufficient in themselves, and for proper motor behavior, sensory inputs are absolutely necessary.

The studies of Sprague et al. (217) in the cat confirmed the importance of incoming information for normal functioning of the brain. These authors destroyed the lateral portion of the upper midbrain, including the main sensory pathways, and they observed that, in addition to the expected marked sensory deficit, the cats exhibited a lack of affect, aggression, and pleasurable responses, and did not solicit petting. The animals remained mute, expressionless, and showed minimal autonomic responses but in spite of this passivity, they showed hyperexploratory activity with incessant stereotyped wandering, sniffing, and searching as if hallucinating. "Without a patterned afferent input to the forebrain via the lemnisci, the remaining portions of the central nervous system . . . seem incapable of

elaborating a large part of the animal's repertoire of adaptive behavior" (217).

Psychological data also confirm the essential importance of continuous reception of inputs, Experiments on sensory deprivation in animals and man have shown that maintenance of

normal mental activity is difficult or impossible when sensory information is reduced and, moreover, that monotonous sensation is aversive. Animals and humans require novelty and continual and varied stimulation from their surroundings.

Perception of the environment has positive reinforcing properties, and when monkeys were confined in a cage, they would press levers and perform other instrumental responses for the reward of opening a little window and looking at the outside world. Curiosity derives from expectancy of novel sensory stimulation and motivates exploratory behavior in both animals and man, while boredom has negative reinforcing properties and is related to the absence of novel sensory inputs (16, 95). To be entertained means to be provided with new and changing sensations, mainly visual and auditory. Primitive man probably derived pleasure from looking at the changing beauty of nature, which retains its fascination to the present day. Civilization has provided the technical means for a far greater choice of inputs, and a major portion of our time, effort, mental activity, and economic resources are now devoted to entertainment through books, theaters, radio, television, museums, and other cultural media.

Symbolically we may speak about "psychic energy" as the level of intracerebral activity which could perhaps be identified in neurophysiological terms by electrical and chemical processes located at specific neuronal fields. This psychic energy may be considered a main determinant of the quantity of intellectual and behavioral manifestations. While this energy obviously depends on cerebral physiology (and indirectly on the health of the whole body), its actual source is extracerebral because mental activity is not a property of neurons, but is contingent on the received information which activates stored information and past experiences, creating emotions and ideas.

To be alone with our own mind is not enough. Even if all past experiences are included, the exclusion of new perceptions creates serious functional difficulties. This has been shown for instance in the studies of Hebb and his group (18, 103) in which

college students were asked to lie comfortably on beds in soundproof, lighted cubicles, wearing translucent goggles to minimize optic sensation and gloves with cardboard cuffs to limit tactual perception. The purpose of this isolation experiment was not to cut out all sensory stimulation, but only to remove patterns and symbolic information. Most of the subjects expected to spend their idle time alone reviewing their studies, planning term papers, or organizing ideas for lectures. The surprising result-for the investigators as well as for the participants was that the students "were unable to think clearly about anything for any length of time, and their thought process seemed to be affected in other ways." After several hours of isolation, in any of them began to see images, such as "a rock shaded by a tree, " "a procession of squirrels," or "prehistoric animals walking about in a jungle." Initially the subjects were surprised and amused but after a while their hallucinations became disturbing and vivid enough to interfere with sleep. The students had little control over these phenomena which, in some cases, included acoustic as well as optic perceptions such as people talking, a music box playing, or a choir singing in full stereophonic sound. Some subjects reported sensations of movement or touch, or feelings of "otherness," or that another body was lying beside them on the bed. Isolation also tended to increase the belief in supernatural phenomena and several of the students reported that for a few days after their isolation experiment, they were afraid that they

were going to see ghosts. The conclusion was that "a changing sensory environment seems essential for human beings. Without it, the brain ceases to function in an adequate way and abnormalities of behavior develop" (103).

In patients with long-term hospital confinement in bed or in an iron lung or body cast, psychotic-like symptoms have appeared including anxiety, delusions, and hallucinations which did not respond to standard medical or psychiatric treatment but were easily alleviated by social contact or by sensory stimulation from a radio or television set (141).

In our century the classic punishment of solitary confinement has been combined with sleep deprivation and used in psychological warfare. Exhaustion and decreased sensory inputs are known to cause mental disturbances and reduce defense mechanisms, and they have been effectively manipulated during "brainwashing" or "thought reform" procedures to indoctrinate prisoners (141, 244).

The literature on sensory deprivation is voluminous (197) and shows conclusively that the cerebral cortex requires a stream of stimulation for the preservation of behavioral and mental normality. We should realize, therefore, that our cerebral and mental functions rely on the umbilical cord of sensory inputs and become disrupted if isolated from the environment. This fact has been recognized by philosophers and is reflected in the words of Ortega y Gasset (167) who wrote: "Man has no nature; what he has is a history," and "I am I and my circumstance." The recognition of environmental inputs as a part of personal identity is one of the important contributions of Ortega, and this idea is presented in *Meditations on Quixote* (166), when one of the characters states that "circumstantial reality forms the other half of my person," and "reabsorption of circumstances is the specific destiny of man." A similar thought is expressed in Tennyson's poem "Ulysses" when Ulysses says, "I am a part of all that I have met."

Ortega's position is important to philosophical thinking, but we should probably go further and question the existence of that half of personal identity thought not to originate in the environment. If we could erase all individual history, all circumstances and experiences, would there be anything left of our personality? The brain would remain and neuronal nets would perhaps continue their spiking activity, but devoid of history of past experiences and knowledge—there could be no mental activity and the mind would, in fact, be an Aristotelian *tabula rasa*. Let us remember with Dobzhansky (64) that "genes determine not 'characters' or 'traits' but reactions or response." The frame of reference and the building blocks of our per-

sonality are the materials received from the outside. The role of cerebral mechanisms, which to a great extent are also determined by previous experience, is to receive, bias, combine, and store the received information, but not to create it. Originality is the discovery of novel associations between previously received information. We must realize that the anatomical structure of the brain has not evolved perceptibly in the past several millennia of man's history; what has changed is the amount of information received by the brain and the training to deal with it. The major differences between a cave man and a modern scientist are not genetic but environmental and cultural.

For centuries philosophical tradition has accepted the existence of the "I," "soul," or "ego" as an entity, more or less metaphysical, relatively independent of the environment (and perhaps even of the genes), which is the "essence" that endows individual man with his unique personal identity and characteristics, and may later be threatened or disallowed by the social medium.

The concept of this mythical "I" is so strong that it has permeated the thinking of authors as original and revolutionary as Marcuse. In *One-dimensional Man* (1954), he distinguishes between true and false needs, declaring:

False are those which are superimposed upon the individual by particular social interest in his repression.... Most of the prevailing needs to relax, to have fun, to behave and consume in accordance with the advertisements, to love and hate what others love and hate, belong to the category of false needs ... which are determined by external forces over which the individual has no control.... The only needs that have an unqualified claim for satisfaction are the vital one - nourishment, clothing, lodging.

According to Marcuse, inner freedom "designates the private space in which man may become and remain 'himself.'... Today the private space has been invaded and whittled down by technological reality."

The basic questions are obviously, who is this "himself," and what is the origin of its structural elements? Is there any way to provide the experience which will form a baby's mind except by means of the "external powers" of parents, teachers, and culture over which the baby has no control? Are we then going to classify a child's needs as false because they were inculcated? Where is the inner man?

Marcuse's pleas for "intellectual freedom" and his criticism of "material and intellectual needs that perpetuate obsolete forms of the struggle for existence" are certainly valid, but the state of unqualified liberty cannot be supposed to exist for the infant who is totally dependent physically and psychologically on his surroundings. Freedom must be taught and created.

The mutual dependence of the individual and the "psychic environment" or "noosphere" has been elaborated by Teilhard de Chardin (1881-1955), who wrote that the Universal and Personal "grow in the same direction and culminate simultaneously in each other ..." the "Hyper-Personal" consciousness at the "Omega point." While it is true that each of us personally receives, interprets, and feels the world around us, why should our individual half be opposed to the noospheric half? Teilhard de Chardin, like Ortega y Gasset and most other philosophers, accepts the existence of the quasi-mystical, inviolable self, an entity somehow identified with the individual mind, ego, or personality, which is related to the environment but has a relatively independent existence.

Recent neurophysiological and psychological studies discussed here reveal that this is not the case. The origin of memories, emotional reactivity, motor skills, words, ideas, and behavioral patterns which constitute our personal self can be traced to outside of the individual. Each person is a transitory composite of materials borrowed from the environment, and his mind is the intracerebral elaboration of extracerebral information. The "personal half" is a regrouping of elements of the environment. For the final result, which is manifested as individual reactivity

and behavioral responses, the building blocks from culture are more decisive than the individual substratum within which the regrouping is performed.

It is impressive that this is actually the philosophy, as described by Lévi-Strauss (1908-2005), of the Bororo Indians, a very primitive tribe living by the Vermelho River in the Arfazon jungles of Brazil. For the Bororo, a man is not an individual but a part of a sociological universe. Their villages exist "for all eternity," forming part of the physical universe along with other animate beings, celestial bodies, and meteorological phenomena. Human shape is transitory, midway between that of the fish and the arara.

Human life is merely a department of culture. Death is both natural and anticultural, and whenever a native dies, damage is inflicted not only on his relatives but on society as a whole. Nature is blamed and Nature must pay the debt; therefore, a collective hunt is organized to kill some sizable animal ' if possible a jaguar, in order to bring home its skin, teeth, and nails which will constitute the dead man's *mori*, his everlasting personal value.

The conclusion that human beings are part of culture does not deny the fact that "individuals" have "individual" reactions and that their brains are unique combinations of elements, but simply points to the source and quality of the factors of personal identity. The cerebral mechanisms which allow us to receive, inte7pret, feel, and react, as well as the extracerebral sources of stimuli, can and should be investigated experimentally. Then we shall gain a new awareness of the structure of the individual and its relations with the surrounding noosphere.

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