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## Jose Delgado's "Physical Control of the Mind"

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### Hallucinations, Recollections, and Illusions in Man

Hallucinations may be defined as false perceptions in the absence of peripheral sensory stimulation, and they probably depend on two processes: (1) the recollection of stored information and (2) its false interpretation as an extrinsic experience entering through sensory inputs. Very little is known about the cerebral mechanisms responsible for these phenomena, but apparently the frontotemporal region of the brain is somehow involved because its electrical stimulation may evoke hallucinations.

In some patients electrical stimulation of the exposed temporal lobe has produced the perception of music. Occasionally it was a determined tune which could be recognized and hummed by the subject, and in some cases it was as if a radio or record were being played in the operating room. The sound did not seem to be a recollection but resembled an actual experience in which instruments of an orchestra or words of a song were heard (174). These artificially induced hallucinations were not static but unfolded slowly while the electrode was held in place. A song was heard from beginning to end and not all at once; in a dream, familiar places were seen and well-known people spoke and acted.

Like spontaneous memories, the recollections induced by ESB could bring back the emotions felt at the time of the original experience, suggesting that neuronal mechanisms keep an

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integrated record of the past, including all the sensory inputs (visual, auditory, proprioceptive, etc.) and also the emotional significance of events. Electrical stimulation activated only one memory without reawakening any of the other records which must be stored in close proximity. This fact suggests the existence of cerebral mechanisms of reciprocal inhibition which allow the orderly recall of specific patterns of memory without a flood of unmanageable amounts of stored information. In no case has brain stimulation produced two psychical experiences at the same time, and the responses have been on an all-or-nothing basis.

In one of our patients, complex sensory hallucinations were evoked on different days when the depth of the tip of the left temporal lobe was electrically stimulated. The patient said, "You know, I just felt funny, just now. . . . Right then all of a sudden somethin' else came to me - these people -the way this person talked. This married couple-as though the fellow came into my mind-as though like he was saying somethin' like oh my mind drifted for a minute-to somethin' foolish... It seemed like he was coming out with some word - sayin' some word silly."

The fact that stimulation of the temporal lobe can induce complex hallucinations may be considered well established, and this type of research represents a significant interaction between neurophysiology and psychoanalysis (133). The mechanism of the evoked hallucinations, however, is far from clear, and it is difficult to know whether the experiences are new creations based on the recombination of items from memory storage and thus equivalent to psychotic hallucinations, or if the experiences are simply an exact playback of the past. In either case, the applied electricity is not "creating" a new phenomenon but is triggering the orderly appearance at the conscious level of materials from the past, mixed in

some cases with present perceptions. The order in the stream of perceived information is perhaps one of the most interesting qualities of this behavior because it indicates something about the mechan-

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isms for storage of information in the brain. Memory does not seem to be preserved as single items but as inter-related collections of events, like the pearls on a string, and by pulling any pearl we have access to the whole series in perfect order. If memory were organized in this way, it would be similar to the strings of amino acids forming molecules of proteins and carrying genetic messages. Electrical stimulation may increase general neuronal excitability; and the memory traces which at this moment have a lower threshold may consequently be reactivated, reaching the perceptual level and forming the content of the hallucinatory experience while exerting a reciprocal inhibitory influence upon other traces. The excitability of individual traces may be modified by environmental factors and especially by the ideological content of the patient's thoughts prior to stimulation. Thus electrical excitation of the same point may produce a series of thematically related hallucinatory experiences with different specific details, as was the case in the patients that we have investigated.

All sensory inputs suffer distortion during the normal process of personal interpretation, which is determined to a great extent by past experience and depends heavily on cultural factors. A baby looking at the moon may extend his arms in an attempt to catch it without realizing the remoteness of celestial bodies. By comparing past and present experiences, we learn to evaluate distance, size, intensity, and other qualities of inputs. The mechanisms for these evaluations do not seem to be genetically determined and are related to neuronal activity which may be influenced by direct stimulation of the brain. We must remember that our only way to be in touch with external reality is by transducing physical and chemical events of the surroundings into electrical and chemical sequences at the sensory receptor level. The brain is not in touch with the environmental reality but with its symbolic code transmitted by neuronal pathways. Within this frame of personal distortion, our lives evolve within a range of "normality." Beyond this range, the distortion of perceptions qualifies as illusion. Illusions occur in a wide variety

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of regressed mental states, during moments of keen anticipation, and as a primary manifestation in some epileptic discharges. An hallucination is a false perception in the absence of sensory inputs, while an illusion requires an external sensory source which is misinterpreted by the individual. This distinction is convenient, and it will be observed in our discussion, although in practice the terms often overlap.

The following phenomena have been observed in patients: (1) illusions (visual, auditory, labyrinthine, memory or déjà vu, sensation of remoteness or unreality), (2) emotions (loneliness, fear, sadness), (3) psychical hallucinations (vivid memory or a dream as complex as life experience itself, and (4) forced thinking (stereotyped thoughts crowding into the mind). The first three groups of phenomena have been induced by different intracerebral stimulations. The most commonly reported effect has been the illusion of familiarity or déjà vu, which is characterized by surprise, interruption of conversation, and immediate spontaneous reporting that something unusual had just happened. For example, after a stimulation in the inferolateral part of the frontal lobe, one patient began to reply to the interviewer's question but suddenly stopped and said, "I was thinkin' - it felt like someone else was asking me that before." Occasionally a previously initiated statement would be completed, but there was always an overt desire to express the perceived experience. The effect was clearly felt as intrusive although not disturbing. After several of these experiences, the patient recognized the special quality of the phenomena and said, for example, "Hey - I had another strike. I have a feeling that someone once told me that before." The reliability of the response was remarkable, as was the consistency of its reporting,

which was spontaneous and in most cases unsolicited. Each instance consisted usually of a reference to a remark made by the patient or the observer just before or during the moment of stimulation. The ideational content of the déjà vu was therefore dissimilar following each stimulation, but it always referred to the theme of the ongoing conversation,

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The common feature was the sensation, expressed by the patient, that the words, ideas, or situation were similar to a previous experience. There was no new perception, only the interpretation of a novel input as one already known and familiar. There was no anxiety or fear in the perception of these illusions, and the apparent effect was one of interested surprise with a rather pleasant, amusing quality which made the patient more alert and communicative. He was eager to report that something similar had happened before, and the word "before" was used in reporting most of these incidents. No lasting traces could be detected, and after the sensation of familiarity had been expressed, the patient's behavior continued in the same vein as before stimulation.

Knowledge of the cerebral mechanisms of psychic activities is so elemental that it would not be wise to speculate about the neuronal causality of illusions of familiarity. However, the fact that they may be elicited with reliability indicates the probable existence of interpretive functions in a determined area of the brain and opens the way for further experiments studies of how sensory inputs are processed by the individual. Penfield supposes that the cortex of the temporal lobe has a ganglionic mechanism which is utilized in the personal assessment of experiential reality regarding distance, sound, sight, intensity, strangeness, or familiarity of sensory inputs. This mechanism would be relatively independent from the mechanism utilized in the recording of contemporary experience and could be affected by epileptic abnormality or by direct brain stimulation. If we accept this hypothesis, we may assume that artificial influencing of electrical and chemical neuronal physiology could play a decisive role in the interpretation of reality with some independence from past experience and personal structure.

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