

T I M E

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Since very early days, time has bedazzled and intrigued humans. More than 1500 years ago, Indians identified time as the basis for mundane reality. They equated the creation of time as the first step in the creation of the universe. This age-old belief received scientific confirmation in Einstein's theory of relativity. Einstein also added support to the concept that time and the mundane reality are both non-substantial. Time, Einstein showed, was relative and therefore, the mundane world with time as its basis also had to be ephemeral. Change in the flow of time triggers drastic changes in matter and its formations. The flow of time is subject to influence by such factors as gravity, and it does not flow at the same rate in different parts of the universe. Even here on Mother Earth, atomic clocks have been shown to tick at different rates on mountaintops and in supersonic jets.

The mathematical concept of time has a better scientific basis and is preferred by the purists. Nevertheless, for most people, time means a personal experience of time. Humans experience time both subjectively and objectively. The swing of the pendulum, the movement of the clock's hands, and the sunrise and the sunset are some of the perceptual indices of the passage of time. We also have an inner sense of time; even in the absence of perceptual cues, we are aware of the flow of time. A number of bodily functions, of which one is barely aware and over which one has minimal volitional control, are time-based. Most, if not all, biological phenomena are cyclic (cycles per unit of time). Breathing and heartbeat are good examples of this. While some biological functions have long cycles (menstrual cycle, for example), others (like pulse) are much shorter. Many endocrine and autonomic functions have diurnal cycles.

The electroencephalogram (EEG) that provides information about levels of brain activity is also cyclic. The crests and troughs that characterize EEG readings form the objective basis for dividing the human experience into three broad categories: wakefulness, dream sleep and dreamless sleep. In fact, the entire human life is contained within these three chapters. The ancient Sanskrit word “aum” is derived from three letters, one representing each of these three phases. Aum, which is closely related to the Latin “omni”, means “everything”. Both “Omni” and “Aum” have strong religious and spiritual connotations.

Time perception is different during these three phases. It is strongest during wakefulness, somewhat weak during the dream phase, and almost absent during the dreamless phase. If time, a created element, is not substantial, the waking experience built around it should also be phantas-

mal. By the same token, dreamless sleep (where time is felt minimally) should be the most “real” of the three, with the dream phase falling in between. According to the eighth century Indian philosopher Samkara, “In the dream state where there is no object, mind on its own creates everything; and it also creates everything seen when awake as well. There is little difference between the two states. Everything we see is a creation of the mind.” “During dreamless sleep when there is no object at all, no pleasure or pain, consciousness shines in its own glory.”

From the very early days, humans were not totally satisfied with the mundane experience and the associated reality. Intuitively, they questioned its validity and explored ways and means for achieving more satisfying states of mind. Among the many routes they found, the use of drugs was the earliest and the most widely used. The ancients came across a number of vegetal derivatives with marked effects on the quality of the conscious experience. In 1500 BC, the Aryan hordes that came over the Himalayas to the Indo-Gangetic planes brought with them the mythical drug, soma. According to the Rig Veda, their ancient anthology of hymns, soma catalyzed communion between humans and gods. “We have drunk the soma; we have become immortal; we have gone to the light; we have found the gods. What can hatred and the malice of mortals do to us now?” The botanical identity of soma is a matter of controversy, although R. Gordon Wasson of the Botanical Museum of Harvard University identified it as *Amanita muscaria*.

Elsewhere in the world, other consciousness-altering drugs gained popularity and acceptance. The Aztecs used Mexican mushrooms while the Huichol turned to peyote. Other South Americans found ayahuasca effective while African tribes in Gabon and the Congo found ibogaine (*Tabernathe iboga*) useful. The Indian hemp (*cannabis sativa*) is one of the earliest and probably, the single most popular consciousness-altering drug. Evidence suggestive of its earliest use comes from the island of Taiwan over 10,000 years ago. It was used in India,

even prior to 1500 BC, before the Aryans arrived. Evidence suggestive of its use by other ancient civilizations including the Egyptians, Babylonians, Assyrians, Scythians, Greeks, and probably, Hebrews, can be found.

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edly consciousness-altering drugs on time perception should be of interest. Unfortunately, such research is not easy. Of the 150 or so such drugs known to Western science, very little pharmacological information is available on most. Many of these plants contain chemi-

cals other than the substance responsible for the consciousness-altering effects, and these effects too have to be taken into account. Several of these plant extracts are too toxic to be administered to human volunteers. Identification, isolation, and purification of the active ingredient are by no means easy and have not been carried out in many cases. Animal studies are obviously easier; however, animals will have difficulty communicating altered consciousness to the experimenter. Animals do not seem to care for many drugs used for consciousness alteration in humans, such as peyote and psilocybin, which would suggest brain mechanisms unique to humans.

Although there is not a great deal of scientific information in this area, the effects of some these drugs on time perception are known. Peyote cactus, LSD and marijuana all produce significant distortions of time. The available few studies vary substantially in sophistication.

The effects marijuana and its active ingredient tetrahydrocannabinol (THC) on time perception have received more scientific attention. Marijuana was found to slow both the subjective and objective perception of time. Many studies demonstrated altered time sense and the underproduction of time estimations. In one study, 28 daily marijuana users displayed greater time underproduction than 32 normal controls which indicated that the

marijuana-induced time distortion may persist beyond the acute phase of intoxication.

Dr. William H. Wilson and I attempted to track the neurological basis for the marijuana-induced alteration in time perception. Using positron emission tomography, we identified the cerebellum as the brain region responsible for mediating this effect. The relationship between altered cerebellar activity and impaired time sense is in keeping with several previous reports that linked the cerebellum to an internal timing system.

Other investigators showed that the cerebellum was involved in the temporal sequencing of motor activity. In human subjects, cerebellar lesions were associated with impairment in rhythmic tapping, a time-dependent task. Patients with cerebellar atrophy were found to be deficient at judging the relative duration of time intervals. Traditionally, the cerebellum has been associated with maintaining balance and coordination of movements. It may indeed also be responsible for the timing function essential both for balance and coordination.

This finding needs confirmation. Studies on the effects of other consciousness-altering drugs on time perception should be conducted. We have started projects on the effects of ketamine and mescaline.

Change in time perception is accompanied by a number of other phenomena including distorted sensory perception and an altered sense of self (depersonalization). Time transcendence, regardless of how it is brought about, often ushers in a very unique sense of well being, usually referred to as joy or bliss. Ancient Indians called it "ananda". Unlike the mundane pleasure that contrasts with pain, ananda is unimodal with no antipode. It is totally ineffable: it has to be experienced. Ananda has two other accompaniments: "Sat" or truth and "Chit" or illumination. Together, sat, chit, and ananda (Sacchitananda) stand for divinity.

The desire to overcome mundane reality is just as strong today as it was in the early days. With the giant

strides in biochemistry and pharmacology, newer or more refined drugs have made their appearance. LSD, mescaline, and THC are good examples. Newer drugs

including MDMA (Ecstasy) have entered the scene and are gaining popularity, especially among adolescents. All regulatory agents and agencies are concerned about their ever-increasing appeal.

As was noted previously, a number of these drugs suffer from serious toxicity problems. In substance abuse clinics across the country we tell our patients, espe-

cially adolescents, about the bad effects of certain drugs in hopes that it will deter them from engaging in their use. That would seem to be a feeble approach to quell and contain the consuming passion for consciousness alteration that spans our entire human history. Unfortunately, at a time when physicists and mathematicians are actively engaged in the study of time, in neurosciences, we seem to have minimal interest in time perception and seem obsessed in demonstrating how drugs which alter time perception are "bad for us".

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