

The Marihuana-Induced "Social High"

Neurological and Electroencephalographic Concomitants

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Ten healthy freshman medical students who had previous extensive experience with marihuana smoking were allowed to inhale the compound in the laboratory until they had reached their usual "high." The observed overall effects were mild or minimal. In the electroencephalogram, there occurred a slight but statistically significant shift toward slower α -frequencies. There were no significant changes in cerebral evoked responses. Results of the neurological examination remained normal. Vibratory sense appreciation improved slightly. Mental status examination showed a slight decrease in intellectual efficiency, some excess jocularity, and a slight loosening of associations. Bender-Gestalt drawings were executed slightly more poorly after drug inhalation than before. It is concluded that the subjective pleasure and relaxation which are experienced as a result of marihuana smoking are accompanied by a very slight decrease in highest cortical functions.

In view of the vast publicity marihuana has received in recent years, it is surprising that there are relatively few modern studies dealing with its effects on cerebral functions. A review of the literature, as well as a literature search through the Medical Literature Analysis and Retrieval System (MEDLARS) revealed by the end of 1969 only one reported study dealing with the electroencephalographic effects of marihuana smoking in humans. It was performed

more than 20 years ago.^{1,2} The best description of the neurological status also dates back to the LaGuardia report in 1944.³ Inasmuch as marihuana obviously induces mental changes in the user, a clinical neurological and EEG evaluation of subjects under the influence of the drug was clearly of interest.

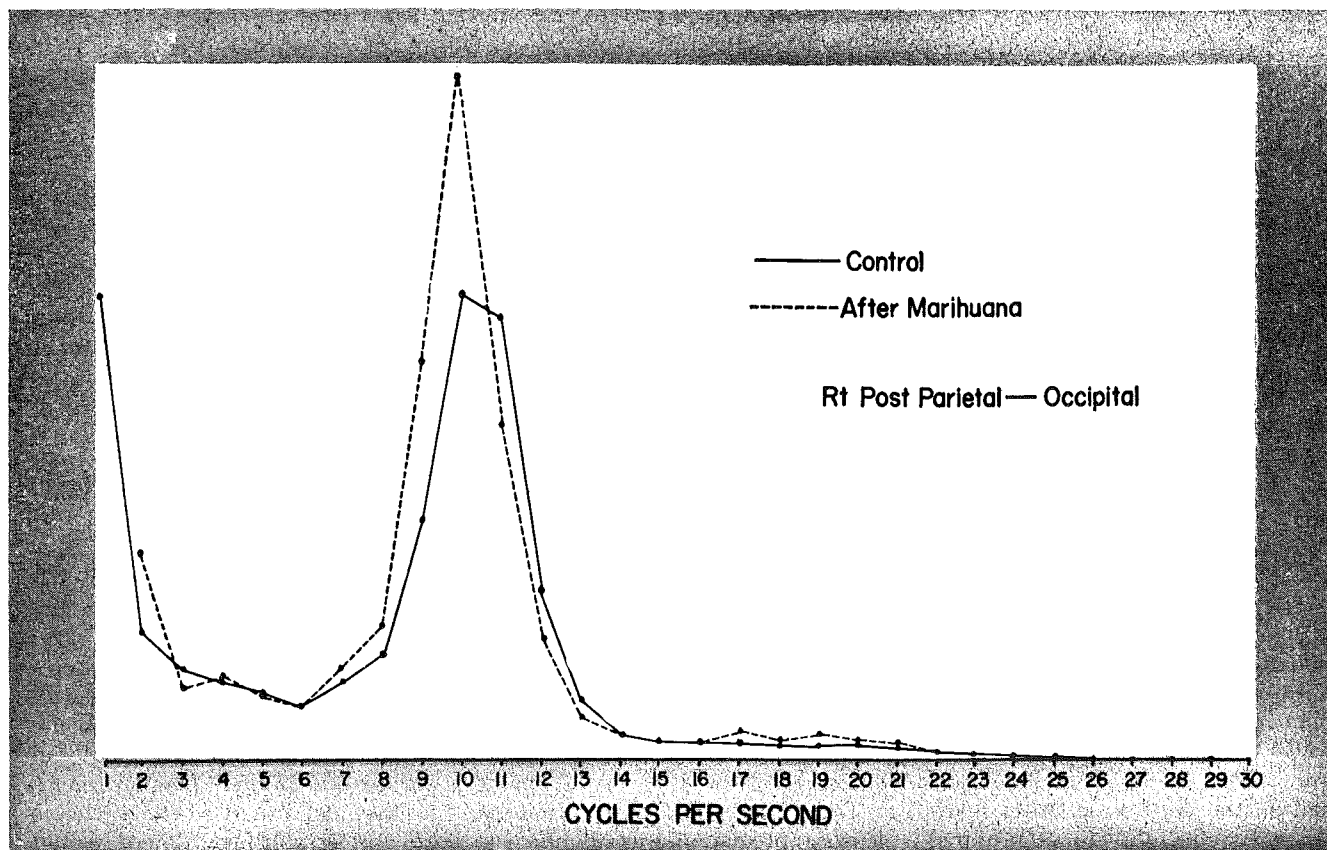
Material and Methods

Ten healthy, male freshman medical students who admitted to long-term use of marihuana were the subjects in this investigation. Baseline histories, neurological examinations, Bender-Gestalt tests, and routine EEGs were obtained. Two to three weeks later, the subjects returned individually to the laboratory for the experiment. While they

were connected to the electroencephalograph, an interview was taped discussing the subject's reasons for smoking marihuana as well as its potential hazards. Vibratory sense appreciation was also tested at the time. Thereafter, another baseline EEG, including a test for photic driving, was obtained and transmitted to the clinic's computer. Evoked response averaging for 15 different head locations was carried out for three different sensory modalities: light, sound, and passive joint movement. After these control observations, the subjects were given cigarettes to smoke containing 300 mg of No. 1 marihuana from the National Institute of Mental Health (NIMH) (supposed Δ^9 -tetrahydrocannabinol [THC] content, 1.312%). They were allowed and actually encouraged to smoke as many cigarettes as they desired in order to reach their usual subjective "high." On the average, two to three cigarettes were consumed per subject (870 mg \pm 80 mg). In case of doubt whether or not drug effect was present, the subjects were urged to continue smoking until doubt was removed in favor of a definite effect. The EEG was monitored throughout marihuana inhalation. Data acquisition for computer analysis was done immediately after the subject had reported the presence of his usual "high" and evoked response averaging was also repeated at that time. Thereafter, another interview, including a brief assessment of mental status, was recorded on tape; neurological examination, vibratory sense determination, and Bender-Gestalt tests

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Power density spectrum of ten volunteers before and after marihuana inhalation. Decrease in the 11-cps and increase in the 9- and 10-cps components are statistically significant. Marked amount of 1- and 2-cps activity is artifactual and should be disregarded.

were repeated. The subjects were thereafter taken for further studies to other laboratories of the clinic. The EEG information was subjected to power density spectral analysis and evoked-response-averaging plots showed not only the mean values of the curves, but also the standard error as well as the differences in the curve before and after smoking. The results of the Bender-Gestalt tests were randomized and scored on a blind basis by means of the Hutt Psychopathology Scale.⁴

Results

Baseline Observations.—All subjects came from white middle class or upper middle class American families. They had not had any serious medical, neurological, or psychiatric illnesses and they came from intact family units. All had used some other “psychedelic” drug at some time. Among these were mescaline,⁹ lysergic acid diethylam-

ide (LSD),⁵ hashish,³ as well as THC and psilocybin. Only one subject admitted to taking other drugs during the month the experiments were conducted. All subjects had smoked marihuana for at least one year prior to examination. The frequency of smoking ranged between five to six times a week and once a week for nine subjects, while one student reported smoking twice a month. Findings of neurological examination, mental status, and EEG were normal in all instances.

Findings Associated With the “Social High.”—On visual inspection alone, it was impossible to distinguish the premarihuana from the postmarihuana EEG, although there was a suggestion that after smoking, there was somewhat more persistent α -rhythm and that its frequency components had become slower by $\frac{1}{2}$ to 1 cycle per second. Power density spectral analysis confirmed this impression, indicating that the 11- and 12-cps components

had decreased and the 9- and 10-cps components increased. This finding was statistically significant at the 0.05 level (Figure). There was no consistent change in the photic driving response or in the average evoked responses, regardless of stimulus modalities.

The findings of neurological examination, except for mental status, had remained completely normal. Specifically, there was no evidence for ataxia or impairment of cortical sensation. On the contrary, vibratory sense appreciation had slightly improved in six of nine subjects (the measurement had accidentally been omitted in one subject after the experiment) and the finding was significant at the 0.05 level. On examination of mental status, there was no evidence for illusions, hallucinations, or paranoid or delusional thinking. Nevertheless, thinking appeared to be altered in a very subtle fashion. It had lost some of its preciseness

Associations had become somewhat looser, there was some excess jocularity, and the prosody of language tended to show a slight sing-song type pattern. Proverbs continued to be interpreted in an abstract manner, but some subjects began to trail off into concrete irrelevancy after having given initially an abstract response. Serial 7 subtractions were carried out slower and there was a tendency towards more errors.

The Bender-Gestalt test showed a slight worsening after marihuana smoking. The initial test results were already significantly poorer than in a nondrug-using college-student control sample, but they were still at the upper limits of normal on the Hutt scale. After marihuana smoking, the group mean had become abnormal, falling into the lower end of a neurotic patient population. Apart from the objective scores, there were some additional observations of interest. The striking feature of the drawings, even in the baseline state, was carelessness in seven subjects and expansiveness in five. The designs were hurriedly executed and half of the students used two pages instead of the more common practice of fitting the designs onto one page. These tendencies were in general somewhat exaggerated after marihuana smoking, in spite of the fact that most of the volunteers had been trying very hard to impress the examiner that they were able to function better or at least as well while they were experiencing the drug effect. At the conclusion of the experiments, the subjects stated that they were definitely "high." This state was characterized subjectively by a feeling of pleasure and relaxation but, to the observer, the volunteers appeared to show a mild degree of "frontal lobishness."

Comment

The marihuana-induced "social high" was found to have been asso-

ciated with only mild or minimal cerebral electrical and neurological changes. In Wikler et al's study, likewise only minimal EEG changes were noted.^{1,2} Their subjects—long-term narcotics addicts—showed only some increase in muscle tension and a slight decrease in amount of α -rhythm in the acute situation. Slight slowing of α -rhythm was observed in four of their six subjects who were allowed to smoke several daily doses for 39 days. Slowing of EEG background rhythms tends to occur in certain toxic or degenerative processes. At the present time, however, it is regarded as clinically significant for the adult only when it reaches frequencies of less than 8 cps.

The observation that vibratory sense appreciation was slightly increased after marihuana smoking would lend credence to the statement by the user that sensory impressions are enhanced. This may lead him to believe that he is now endowed with artistic creativity. The pleasure derived from use of the drug, however, is probably due not only to enhanced sensory impressions, but also to a decrease in critical judgment and loosening of inhibition. The combination of these factors is likely to lead the subject to believe that he is performing better under the influence of the drug. The objective observer, on the other hand, fails to see the claimed improvement in actual work output, cannot participate in the experienced pleasure, and is therefore bound to take a negative attitude towards the marihuana effects.

Our subjects stated that the quality of the marihuana which we dispensed had been "average" in comparison to what they ordinarily smoked privately. They also stated that, had the substance been of higher quality, they would have smoked a lesser amount in order to get the same effects. This is emphasized because the exact Δ^9 -THC content for our marihuana is not

clear. According to NIMH, the batch was supposed to have had a Δ^9 -THC content of 1.312%. When samples of the same material were sent for assay to two independent laboratories, Δ^9 -THC contents of 0.5% and 0.2%, respectively, were reported. This indicates that the current assay techniques are either quite unsatisfactory or the material deteriorates merely by standing in a safe at room temperature. Investigators should therefore not assume automatically that the marihuana they are supplied with does indeed contain the stated Δ^9 -THC content. They should furthermore insist, if at all possible, that they are being given fresh, high quality material with several different potency ranges so that definite dose-effect curves can be established. These would aid in investigating possible legitimate medical applications which may well be overlooked by our present preoccupation with the hallucinogenic properties of the resin from the flowering tops—hashish. Although *Cannabis* is not likely to possess curative properties, those parts of the plant which have a lower THC content, or small doses of pure Δ^9 -THC, should be explored as a possible way to relieve suffering and produce some euphoria in patients with certain chronic disabling conditions.

Gail R. Twitty, MA, of the Michigan Epilepsy Center helped in the scoring of the Bender-Gestalt tests.

References

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