

The Effect of Long-Term Chronic Marijuana Use on Neuropsychological Functioning

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Abstract

Ten normal subjects who smoked marijuana daily for an average of 5 years and who denied other drug use were examined on a neuropsychological test battery. When compared with normal nonsmoking Ss, minimal differences were observed. It was concluded that long-term cannabis use does not cause a generalized decrement in adaptive abilities which might be related to cerebral impairments.

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A number of recent reports address themselves to the question of the effects of long-term cannabis use on human brain functioning (Table 1). Kolanski and Moore (1971) describe an alarming picture of deterioration of personality functioning in young psychiatric patients. The nature of their data and the biased sampling obscure their interpretation. The sample was based entirely on a patient population and hence is likely to include only casualties or individuals in other psychological difficulties. Other authors have described evidence of cerebral atrophy in young cannabis smokers (Campbell et al., 1971). Despite the implication that cannabis was indicted as the agent responsible for the deteriorative changes, the authors acknowledge that all their subjects used other drugs extensively. A major difficulty in assessing the effect of cannabis in young American users is the pattern of multiple drug use in which this substance is often consumed along with a variety of other drugs (Carlin and Post, 1971, 1974). Attempts to study effects of chronic use of cannabis in other societies which avoid the confounding variables of multiple drug use tend to generate other uncontrolled factors; e.g., poor diet and poverty. Rubin (1974) studied chronic cannabis use among natives of Jamaica where chronic use exists within a social context of relative acceptance and good nutrition. Using a sophisticated test which assesses neuropsychological functioning, they found that cannabis users demonstrated no significant impairments. However, extrapolation to other cultures is difficult. Mendelson and Meyer carried out a well-designed study which compared chronic and moderate young marijuana users along a variety of dimensions, including portions of the Halstead Neuropsychological Test Battery (Mendelson and Meyer, 1972). They report no significant differences between the two groups. Grant et al. have compared moderate users with nonusers; however, a study has not been conducted which compares heavy users and nonusers (Grant et al., 1973). Mendelson and Meyer fail to describe several neuropsychological indicators which have been shown to be highly reliable measures in assessing the organic integrity of the brain (Mendelson and Meyer, 1972). They do not provide details on WAIS performance and hence differences between verbal and performance abilities cannot be seen. Further, they do not show TPT performance by dominant and nondominant hand so that differences in functioning between one side of the body and the other cannot be observed. The present study was designed to further examine brain behavior relationships in a chronic cannabis-using population that denied the use of other drugs and to compare this group with individuals who are not users of any psychotropic substances.

Table 1
References Relative to Cannabis Use and CNS Dysfunction

Campbell et al., 1971

Subjects: 10 patients drawn from neurology and drug abuse clinics.

Intensity of use: Consistently 3 to 11 years.

How assessed: Pneumoencephelogram.

Findings: Cerebral atrophy.

Cautions and comments: Subjects used other drugs heavily.

Kolansky and Moore, 1971

Subjects: 38 psychiatric patients.

Intensity of use: Two times weekly or more for variable lengths of time.

How assessed: Clinical impressions.

Findings: Personality and neurological impairment.

Cautions and comments: Patient population and absence of objective measures of impairment.

Mendelson and Meyer, 1972

Subjects: 10 "normals" who used daily for 1 year, 2 to 5 year history, and 10 "normals" who used 1 to 4 times monthly, with a 1-year history.

How assessed: Halstead-Reitan.

Findings: No impairment.

Cautions and comments: No control group beyond comparing heavy and moderate users. Generally useful findings.

Grant et al., 1973

Subjects: 29 medical students who used three times monthly with a 4-year history and 29 medical students who used none.

How assessed: Halstead-Reitan.

Findings: No differences, except one parameter of neuropsychological testing.

Cautions and comments: Population limited to successful students. Same problem as with Kolansky and Moore, except in reverse direction.

Rubin et al., 1973

Subjects: 30 rural Jamaicans who used 1 to 7 times daily, with a 17-year history, and 30 rural Jamaicans who used none.

How assessed: Assumed to be Halstead-Reitan.

Findings: No differences between users and nonusers.

Cautions and comments: Population tested different than one on which the test instruments were standardized. Different culture and language usage.

METHOD

Individuals were recruited through a grapevine originated by participants in previous marijuana studies conducted by one of the authors (Carlin and Post, 1974). They were required to have smoked marijuana at least daily for 2 years with no history of other drug usage. Those who contacted the investigators were scheduled for screening and were informed that they would be paid for volunteering for the study. An initial 25 Ss called and were screened. Any Ss who had recreationally used drugs other than marijuana on more than 10 occasions or had indications of previous neurological illnesses or injury were excluded (e.g., seizures, encephalitis, meningitis, traumatic head injury, and epilepsy). Ten subjects met the criteria. These ten had used cannabis for an average of 5 years, ranging from $2\frac{1}{2}$ to 8 years. Average age was 24.1 and average education was 14.6 years. Seven Ss were male and three female. All Ss were asked to abstain 24 hours prior to the administration of the Halstead Neuropsychological Test Battery.

A control group matched for age, education, and Wechsler-Bellevue Full Scale IQ's was drawn from the normative population acquired by Reitan (Reitan, 1966). This group had no etiological evidence of brain-related impairment and were screened both neurologically and by neuropsychological examination to rule out histories of psychotropic drug use. The Halstead Neuropsychological Test Battery is described in detail elsewhere (Reitan, 1955, 1959, 1967). Briefly, it consists of the Wechsler-Bellevue Intelligence Test and a variety of behavioral measures which have been shown to be related to the organic integrity of the cerebral hemispheres (Reitan, 1967). One of the most sensitive tests on this battery is a measure designed to evaluate a subject's ability to organize complex abstract concepts in a meaningful manner and profit from immediate feedback as to the adequacy of their performance (Halstead Category Test). This task has been demonstrated to be highly correlated with the presence of cerebral impairment (Reitan, 1955). A number of other tests assess concept formation and problem solving utilizing a combination of tactual and kinesthetic tasks (Tactual Performance Test, Trail Making Test). Also included are measures which identify visual motor functions, sensory perceptual functions, pure motor functions (Tapping), immediate alertness tasks (Rhythm and Speech Sounds Perception Tests), and receptive and expressive language abilities (Aphasia Screening Battery).

RESULTS AND DISCUSSION

The results for both the marijuana-smoking subjects and the normative sample appear in Table 2. Only one difference reached significance. This was on the Trail Making Test, a test which is sensitive to cerebral impairment (Reitan, 1967), tapping a subject's ability to scan a page with

Table 2
Neuropsychological Test Data for Cannabis Users and Controls (N = 10)

	Cannabis users		Control group	
	<i>X</i>	SD	<i>X</i>	SD
Age	24.10	2.23	24.90	6.04
Education	14.60	1.64	14.40	3.27
Verbal IQ	120.3	15.54	123.4	8.75
Performance IQ	122.5	12.17	120.5	9.98
Full-scale IQ	122.60	14.19	124.40	7.27
Information	13.6	3.06	13.7	1.75
Comprehension	12.7	2.66	13.7	2.21
Arithmetic	12.7	4.76	14.5	4.00
Similarities	14.7	2.31	13.9	1.79
Digit span	10.4	2.95	11.4	2.45
Vocabulary	13.7	2.90	13.2	1.98
Digit symbol	14.8	2.39	12.6	2.21
Picture completion	12.7	2.35	12.6	2.59
Block design	13.4	3.23	13.5	2.36
Picture arrangement	13.0	2.44	12.0	2.90
Object assembly	12.9	2.18	12.5	2.17
Trails A	18.7	4.66	20.0	5.96
Trails B	55.8	9.71	60.0*	28.74
Categories	26.9	22.15	25.4	9.84
Tactual Performance Test (TPT), right hand	4.74	1.32	4.85	2.49
TPT, left hand	3.63	1.15	3.25	1.58
TPT, both hands	1.8	0.79	1.61	0.56
TPT, total time	10.2	2.90	9.63	4.20
TPT, location	6.5	1.84	6.1	2.07
TPT, memory	8.3	1.41	8.5	0.84
Speech	4.8	3.25	4.0	2.66
Rhythm	26.6	3.83	27.0	1.24
Tapping, dominant hand	52.0	7.08	51.9	7.63
Halstead Impairment Index	0.15	0.22	0.14	0.06

* $p < .05$.

numbers and letters connecting them sequentially, alternating from numbers to letters. The marijuana-smoking group performed significantly faster than the control Ss. The profile of scores for each individual was clinically evaluated by four inferential methods. These were: level of performance, pattern of performance, pathognomonic signs, and the functional status of both sides of the body (Reitan and Davison, 1974). One subject of the 10 cannabis users manifested clear indications of lateralized cerebral impairment. The other nine generated profiles which fell well within normal limits, as did all of the normals.

Prior to considering the data, the question of reliability of Ss reports of their drug use must be answered. The Ss were not totally aware of the criteria, and Ss not accepted were not told the reason for rejection. Further, it is our own impression that the Ss did not join the study for the inconsequential monetary reward of \$10.00 for 6 to 8 hours of test taking, but rather, apparently to seek reassurance or information about the impact of their drug use. The issue of abstinence for 24 hours prior to testing remains moot, but one can infer that since no indications of mild or acute intoxication were evidenced on neuropsychological testing, comparable to Mendelson and Meyer's (1972) findings for moderate users, and Klonoff's (1973) results for the acutely intoxicated, these Ss were reliable. Klonoff (1973) has indicated that acute intoxication results in a generalized impaired level of functioning which was not observed for our Ss. The one cannabis user who did manifest lateralized impairment does not present a neuropsychological profile consistent with Klonoff's (1973) intoxicated Ss. This Ss profile is suggestive of a focal cerebral insult to his right hemisphere rather than the effects of drug intake which have been shown to have more bilateral effects. It does, however, raise the questions of the possible differential effects of chronic cannabis use on vulnerable individuals. This possibility cannot as yet be completely dismissed.

Our findings do suggest that relatively long-term chronic marijuana use does not impair an individual's ability to solve complex cognitive tasks requiring recurrent observations of subtle stimulus characteristics, to manipulate complex visual motor problems, to answer questions dependent on prior learning, and to be accurate in identifying sensory stimulations, both unilateral and bilateral. If this cannabis-using population had the organic deficits reported elsewhere (Campbell et al., 1971), they certainly would be incapable of performing these tasks with the degree of competence they demonstrated. A question of major importance not answered by this investigation is the extent to which differential vulnerability to the impact of cannabis is possible. The individuals in this

study were quite bright, and it is possible that less bright individuals may present greater risk. This study should be replicated with a broader range of subjects who vary in intelligence as well as age. Although limited in sample size, this study, in conjunction with Grant et al. (1973), Rubin's (1974) and Mendelson and Meyer's (1972) work would suggest that the sequelae of long-term chronic cannabis use is of less consequence to cortical functioning than previously reported (Kolanski and Moore, 1971; Campbell et al., 1971).

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