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# Marijuana Produced Changes in Cutaneous Sensitivity and Affect: Users and Non-Users[1]

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MILSTEIN, S. L., K. L. MACCANNELL, G. W. KARR AND S. CLARK. *Marijuana produced changes in cutaneous sensitivity and affect: users and non-users.* PHARMAC. BIOCHEM. BEHAV. 2(3) 367–374, 1974. – Two experiments were conducted in which both marijuana and placebo were administered double-blind to male and female users and non-users of cannabis. Relative to the placebo condition, the marijuana produced no change in cutaneous sensitivity as measured by 4 objective measures. However, it did produce an increase in happiness and fear for both users and non-users on a standardized affect scale. In addition, although there was a difference in degree of intoxication between the user and non-user groups, the number of subjects in each group who became intoxicated was similar.

IN SPITE of the very common report by users of changes in sensory functioning [33] only three previous studies [2, 28, 31] have attempted to examine sensory effects produced by marijuana. The results of these studies are conflicting. Caldwell *et al.* [2] reported changes in auditory intensity threshold but no change on other auditory parameters. This finding is consistent with that of the Mayor's Commission [31]. In the only previous study to examine cutaneous sensitivity, Rodin *et al.* [28] report that "vibratory sense appreciation had slightly improved in six of nine subjects." Unfortunately the lack of certain controls and the small number of subjects make interpretation of this finding difficult. The two studies reported on here attempted to examine the effects of smoking marijuana on skin and touch sensitivity and on affect.

According to Farnsworth [9], "one of the chief problems affecting legislators with regard to marijuana has been the conflict of opinion on the exact physical and mental effects . . . of this plant. This uncertainty has been due to lack of valid controlled scientific experiments." Weil, Zinberg, and Nelson [34], blamed this lack of controlled experimentation on a variety of methodological, social, legal and ethical problems. Although the social, legal and ethical problems in cannabis research have been reduced and methodology has improved [4, 5, 8, 10, 16, 24, 27, 36] problems still exist with (1) the route of administration, (2) control and specification of dose, and (3) set and setting variables.

There have been few successful attempts to develop a smoking technique and procedure to administer standardized dose of tetrahydrocannabinol (THC) in marijuana. The smoking of marijuana cigarettes is not an entirely satisfactory procedure as considerable and variable amounts of smoke are lost into the air and there is no way of determining actual amount of smoke inhaled by the subjects. An exception to this lack of success is the use of a spirometer by Renault *et al.* [27]. The belief that one can best control THC dose by administering it orally [11,22] has probably contributed to the common use of oral administration techniques. Further, these same investigators claimed that there is no need to develop better smoking procedures as oral and smoked effects can be equated. However, there is some evidence that the oral route of administration produces an effect which is different from that of smoking [16,31]. It is probable that absorption through the gastrointestinal system takes longer than through the lungs and, therefore, the time course of the effects is different. A major problem in comparing results of different studies has been the difference in administration technique and inability to determine the amount of THC actually absorbed.

As it has been clearly demonstrated that marijuana effects are a function of both pharmacological and psychological factors such as set, setting [4,15], and expectancy, it is surprising that most investigations are still carried out in sterile laboratory settings. It is questionable whether the

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results from studies using oral administration techniques or a sterile laboratory setting can be generalized to marijuana effects occuring in a social situation. This difficulty in generalizing from most of the experimental literature is increased by the restricted subject populations that have been used to date. While the precise control of extraneous variables is essential, some studies must be carried out in such a manner that the results be generalized and have some practical value. In reviewing past work on mood changers, the Canadian Commission of Inquiry into the Non-Medical Use of Drugs concluded that, "over the past few years almost all experimental research has been conducted on healthy young males . . . other populations need to be investigated, especially females and adolescents and older persons of both sexes."

These experiments are an attempt to examine some effects of marijuana under standardized, controlled conditions using the route of drug administration and a setting mose closely approaching social usage.

## EXPERIMENT 1

The purpose of this study was to examine the effect of smoking marijuana on absolute pressure and pain sensitivity.

### METHOD

*Subjects*

Sixteen males and females who were experienced in the use of cannabis and 16 males and females who had never used cannabis received 600 mg of 1.3% $\Delta^9$-THC marijuana (M) and a placebo (P) of THC extracted-M double-blind, on 2 different occasions 7 days apart. Each group of 16 subjects (*S*s) contained 8 males and 8 females selected at random on the basis of age and education from a pool of 1500 normal volunteers from a large Western Canadian City. Each *S* was paid $50.00 for participation. All *S*s in the experienced group had used cannabis and been intoxicated previously. The demographic characteristics of each group are given in Table 1. The mean and median for past cannabis use in the experienced group reflect our desire to study a diverse sample of experienced–normal subject. Many previous studies have concentrated on heavy users and therefore, could have been dealing with atypical-pathological individuals. Both groups were instructed to use no alcohol for 24 hr and no other medical or non-medical drugs for 7 days prior to the test sessions. Prior to participation, all *S*s were examined by a physician and psychiatrist and were judged physically fit and emotionally stable. Individuals were excluded who were chronic users of alcohol or hard drugs or who had confirmed cardiovascular, renal, pulmonary or hepatic disease or who were pregnant. All volunteers accepted as *S*s received an explanation of what was involved and signed an informed consent form prior to their participation.

*Drug Administration*

The M or P was administered to *S*s in a standard manner on separate occasions during two 24 hr visits 1 week apart. The order of administration was randomly determined with half the *S*s receiving M and half receiving P first. Both sessions were conducted double blind. To help preserve the double blind a different drug administrator was used on each of the two occasions. The drug administrators did not observe the testing. No member of the research team having contact with the *S*s was informed as to which substance (M or P) was being administered on a particular occasion. Administration on both occasions began approximately nine hours after arrival at the laboratory and took 30 min. As M is typically used in the evening hours, administration took place between 5:30 p.m. and 7:00 p.m. *S*s participated in groups of 2 or 3. Experienced, non-experienced,

TABLE 1

SUBJECT PROFILE STUDY I

| Group | Age | Education Level | Occupations Represented | Marijuana Use During Past Year | Number of *S*s Having Used Other Hallucenogens |
|---|---|---|---|---|---|
| Experienced (n = 16) | Mean = 30<br>Median = 28.5<br>Range = 21–48 | Mean = 13<br>Median = 13.5<br>Range = 8–16 | engineer<br>geologist<br>housewife<br>postal employee<br>sales<br>secretary | Mean = 29<br>Median = 2.5 | 7 |
| Non-Experienced (n = 16) | Mean = 46<br>Median = 40.5<br>Range = 26–70 | Mean = 12<br>Median = 12<br>Range = 10–17 | engineer<br>farmer<br>housewife<br>laborer<br>nurse<br>sales | 0 | 0 |

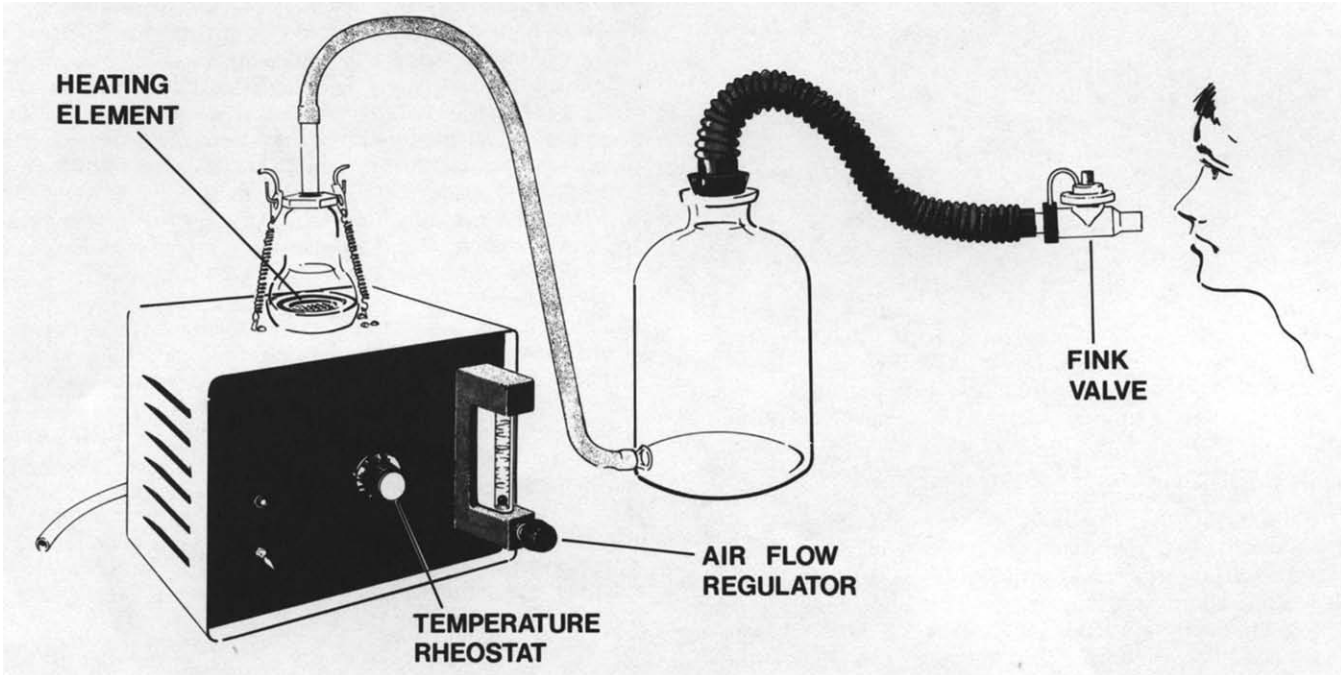


FIG. 1. Illustration of smoking device.

male and female *S*s were never mixed. By spending the whole day in the laboratory prior to participation, the *S*s were able to become more comfortable with each other and the researchers. As part of our attempt to approximate a social usage situation, a non-clinical setting was used. The laboratory consisted of a living room with kitchenette, a bathroom, one bedroom, and two separate test rooms and a control room. The apartment was furnished in a contemporary style which was comfortable to *S*s of all socioeconomic levels. A casual atmosphere was maintained in the apartment and *S*s appeared relaxed in these surroundings. Smoking took place in the living room with all participants present.

Two hundred mg of either M or P were administered every 10 min until the total of 600 mg had been smoked in 30 min. Smoking took place under low illumination with background music. The dose of 600 mg was selected in a pilot study with 14 experienced and 5 non-experienced *S*s in which doses of M and P ranging from 200 to 1400 mg were administered double-blind on two separate occasions. The results of that study indicated that 600 mg was sufficient to produce their usual stone in 13 of the 14 users. Three of the 5 non-users also became intoxicated at a dose of 600 mg.

In order to control as precisely as possible the amount of M administered and to estimate accurately the amount of THC absorbed by the *S*s, it was necessary to develop a smoking device. The device that was developed consists of a constant temperature burning chamber connected to a collecting bottle which is connected to a two-way valve (see Fig. 1). This device is operated by (a) placing 200 mg of either M or P on the heating element, (b) burning it, and (c) then blowing it, with forced air, into the 4 liter collecting bottle. At this point (d) the *S* begins breathing normally through the two-way valve mouthpiece. *S*s were instructed not to hold the smoke in their lungs. While some variability between *S*s was noticed, and some *S*s attempted to hold the smoke, a reasonably standard amount could be delivered and an estimate of THC absorbed could be made. As the smoker is a closed system except for the mouthpiece opening, almost all of the smoke is delivered to the mouth of the *S*.

*Assay*

The NIMH marijuana (batch 2PF-126) was stated to contain 1.5% $\Delta^9$-THC while the NIMH placebo was said to be free of $\Delta^9$-THC. Local assays were done to verify the accuracy of these values and to determine whether there was any change in $\Delta^9$-THC content with storage. In addition, it was necessary to ascertain, by assay, the efficiency of the administration system. This was done in pilot studies. The active marijuana, the placebo and the breathing apparatus were extracted using 100% chloroform or hexane. Expired air was led through a coil contained in a tank at −60° C and then through cigarette filters. The tubing residue was dissolved in 100% chloroform and the cigarette filters were extracted in 96% alcohol. After evaporation of solvent all residues were dissolved in 10 ml of chloroform and, using gas-liquid chromatography, were assayed against a $\Delta^9$-THC standard which was stored under nitrogen. As a result of parallel assays with other laboratories, we have some reason to doubt the stated concentration of the standard, which may be in error by 50%. We believe, therefore, that the active marijuana may contain 1.0% THC rather than the stated 1.5%. Regardless of absolute amounts, under the conditions of our experiments, an average of 34% of the administered $\Delta^9$-THC contained in the marijuana was retained by the subjects. Moreover, the placebo could not have contained more than 0.01% $\Delta^9$-THC. There was little change with time of the $\Delta^9$-THC content of the marijuana.

*Test Procedure*

Two measures of cutaneous sensitivity, absolute pressure and pain, were taken from the volar (anterior) surface of the forearm 30–60 minutes prior to and beginning at 15 minutes after smoking M and P. In order that testing be conducted at a constant intoxication level and to control for fatigue, total test time at each session was limited to 25 minutes. Each *S* was tested individually and in private.

Sensitivity to pressure was determined by the Semmes-Weinstein pressure aesthesiometer. The procedure used was similar to that employed by Milstein and Zubek [25]. Using the method of limits, two ascending and two descending trials were administered to the volar surface of each forearm approximately 8 cm below the elbow. A record was made of the first filament perceived in each ascending determination and the last element perceived in each descending determination. Pain sensitivity was measured by the Hardy, Wolff and Godell dolorimeter connected to a timer. Basal setting of the dolorimeter was at 100 m cal/cm$^2$/sec and the latency in sec from the onset of the stimulus to the first indication of pricking pain was recorded. Four trials were given on the volar surface of each forearm, alternating arms every trial and providing for a 30 sec interval between trials to allow for the dissipation of heat in the test area. Since the periodic application of radiant heat might affect the sensitivity of adjacent test areas for pressure, the pain measure was always taken after completion of the absolute pressure determination. In order to familiarize the *S*s with the test procedures and to control for practice effects, two practice sessions were held. The first was 6 and the other 3 hr prior to the pretest. This same test schedule and standard procedure was followed for each *S* on both occasions. Furthermore, the same set of instructions was given to the *S*s at all practice and test sessions.

Immediately after the end of skin sensitivity testing, and 2 hr later, *S*s were administered a marijuana symptomatology questionnaire. Data derived from this questionnaire will be reported independently. On both smoking occasions the drug administrator made an appraisal whether the *S* was intoxicated, only slightly intoxicated, or not intoxicated. This was done using the criteria of conjunctival redness memory lapse, ability to carry on coherent conversation, and changes in affective state. Further, a note was made as to whether the *S*s considered themselves stoned. Most *S*s volunteered this information without being asked. However, in a few cases, the experimenter had to ask the *S* to describe the way he was feeling. On the second occasion, after completion of all testing, the *S*s were asked what substance they received on the first and on the second occasion (post-hoc identification).

## RESULTS

A three-factor (drug-M vs P, experience vs no experience, Sex-M vs F) analysis of covariance, repeated measure on one factor (drug), with pre-score as a covariate was used to compare the changes in cutaneous sensitivity (both absolute pressure and pain sensitivity) after smoking M and P. Pre-score was used as a covariate to control statistically for possible difference between the experienced and non-experienced groups [35].

The analysis carried out on the presmoking-postsmoking difference scores revealed no changes in absolute pressure sensitivity for the M condition relative to the P condition. There was a statistically significant difference between the experienced and non-experienced *S*s ($p<0.05$) and between males and females ($p<0.01$) on this measure. There were no significant interactions. The analysis of covariance on the change in pain sensitivity was also carried out on the presmoking-postsmoking difference scores. It indicated that there was no statistically significant changes in pain sensitivity for the M condition relative to the P condition nor was there a significant difference between the experienced and non-experienced *S*s, or males or females *S*s. There were no significant interactions (see Table 2 for mean scores for both measures).

The Pearson product-moment correlations for the pain M difference scores and for the pressure M difference scores with *S*s, body weight (r = .20 and .12), with amount of tobacco consumed per week (r = −.07 and −.09) and with estimated cannabis use during the past three years (experienced group only r = .05 and .05) were calculated. These coefficients indicated no consistent pattern to the relationship between any of these variables and the cannabis effects.

Although M did not produce measurable changes in skin sensitivity, it nevertheless produced a state of intoxication which was observed by the drug administrator. Fourteen of the experienced and 14 of the non-experienced *S*s were observed or reported being intoxicated under the M condition. Although the same number of experienced and non-experienced *S*s became intoxicated, only 4 of the 14 non-experienced *S*s became more than slightly intoxicated, compared to 12 of the experienced *S*s. A chi-square calculated to determine whether the degree of intoxication was related to having had previous experience with cannabis indicated that the degree of intoxication and previous experience are not independent ($\chi^2 = 9.338$, $p<0.01$). Only one *S*, an experienced male, responded positively to the P condition.

The correct post-hoc identification of the M condition by 14 experienced and 13 non-experienced *S*s supports the data on subjective state discussed above and clearly demonstrates that the M and P state were subjectively different. On the post-hoc identification measure, the chi-square calculated to determine the relationship between correct identification and past cannabis experience, was not significant ($\chi^2 = 0.238$). As there was no significant difference between the experienced and non-experienced *S*s on the rate of correct identification, their scores were combined and a one-tailed binomial test used to determine whether the correct identification rate was better than chance. This test confirmed that the *S*s correctly identified the M condition significantly better than possible by chance ($p<0.01$).

## EXPERIMENT 2

The purpose of the second experiment was to examine the effect of smoking marijuana on tactual acuity (two-point threshold and tactual fusion threshold).

## METHOD

*Subjects*

The same number of *S*s and same design were used as in Experiment 1. The characteristics of the two groups of *S*s were almost identical to Experiment 1.

TABLE 2

BEFORE AND AFTER MEAN SCORES FOR SKIN SENSITIVITY MEASURES

| Measure | Marijuana | | Placebo | |
|---|---|---|---|---|
| | Before | After | Before | After |
| Pressure Aesthesiometer (Logarithm of force in mg) | 4.32 | 4.25 | 4.30 | 4.12 |
| Thermal Pain (In secs) | 3.65 | 3.63 | 3.67 | 3.70 |
| Two Point Acuity (In mm) | 44.57 | 46.79 | 43.44 | 43.11 |
| Tactual Fusion (In bursts/sec) | 20.61 | 18.23 | 25.93 | 27.15 |

*Marijuana Administration*

M and P administration procedures were the same as in Experiment 1.

*Test Procedure*

Two measures of tactual acuity were taken from the volar (anterior) surface of the forearm approximately 8 cm below the elbow 30–60 min before and beginning 15 min after the administration of M or P. A two-point threshold was obtained by placing the aesthesiometer along the proximo-distal (superior-inferior) axis of the forearm and the method of limits used with two ascending and two descending trials applied to each forearm. The criterion for the two-point threshold for the ascending series was a report of pressure at two points on the skin on two consecutive trials, and for the descending was the report of pressure at one point on two consecutive trials. In order to increase the reliability of the data and control for guessing the *S*s were told they would sometimes be touched with two points and sometimes with one. The tactual fusion threshold was determined by means of a flicker technique developed by Schewchuk and Zubek [29]. This method employs an interrupted jet of air at a specified pressure, the frequency of which can be systematically increased until the *S* reports a constant sensation of pressure on the skin. The frequency at which this occurs is referred to as the critical frequency of percussion. Four trials were given on each forearm with the test area being covered with petroleum jelly to minimize drying of the skin. All stimuli were presented in an ascending order, with pressure at the skin, 28 lbs/in and the tip of the nozzle placed at a distance of 0.5 cm from the skin. The same test area was employed for both measures, however, since repeated application of the aesthesiometer is known to produce a slight redness of the skin, the two-point threshold measure was always taken after completion of the tactual fusion determination. The same test schedule including practice sessions and standard procedures were followed for each *S* on both occasions. These were the same as in Experiment 1.

Immediately after the end of the skin testing, *S*s, were administered the Primary Affect Scale (PAS) and the Symptomatology Questionnaire [14,26]. The Symptomatology Questionnaire was also administered 2 hr later. The PAS contains 5 subscales which measure anger, arousal, depression, fear and happiness and takes a total of 4 min to administer. As in Experiment 1 the drug administrator made a note of the *S*s' apparent state of intoxication and verbal report of their state. On the second occasion, after completion of all testing, the *S*s were asked what substance they received on occasion one and on occasion two (post-hoc identification).

RESULTS

The same analysis of covariance, with pre-score as a covariate, which was used in the preceding experiment was again employed for each measure. The results of the analyses, for both measures of tactual acuity (two point and tactual fusion theshold), which were carried out on the pre-smoking, post-smoking difference scores revealed no changes in sensitivity on either measure for the M condition relative to the P condition. Further there was no significant difference between the experienced and non-experienced *S*s or male or female *S*s. There were no significant interactions (see Table 2 for mean scores for both measures).

The product-moment correlations for the two-point acuity M difference scores and for the fusion M difference scores with *S*s' body weight ($r = -.32$ and $-.32$), with amount of tobacco usually consumed per week ($r = .38$ and $.06$) and with estimated amount of cannabis used during the past three years (experienced group only, $r = -.15$ and $.02$) indicated no significant pattern to the relationship between any of these variables and the cannabis effects.

Figure 2 summarizes the results on happiness and Fig. 3 the results on fear. It can be seen that in the M condition, relative to the P condition, both experienced and non-experienced *S*s show an increase in happiness and in fear. The analyses of covariance performed on these data revealed a statistically significant difference between the M and P condition on happiness ($F = 9.617$, $p<0.01$) and on fear ($F = 7.925$, $p<0.05$). These analyses did not show any difference between experienced and non-experienced *S*s or male and female *S*s. The interactions were also not significant. No significant drug effects were observed on the other three affect scales, nor were significant sex, experience, or interactions effects observed on any of these measures.

The number of *S*s observed intoxicated or reporting intoxication is similar to that of Experiment 1. Under the M condition, 15 experienced and 14 non-experienced *S*s became intoxicated. In this study, however, 11 non-users and 14 users became more than slightly intoxicated compared to 4 and 12 in the previous study. There were three possible P responders: one non-experienced male, one non-experienced female and one experienced male.

The chi-square calculated to determine whether the degree of intoxication was related to previous experience with cannabis was not significant ($\chi^2 = 1.694$). However, inspection of the data suggests a trend of a greater degree of intoxication in the experienced group. The results for the post-hoc identification of the M and P conditions is also similar to the results from Experiment 1 as 15 experienced and 11 non-experienced *S*s correctly identified the M condition. The chi-square calculated to determine the relationship between correct identification and past cannabis experience, indicated that there was no significant difference between experienced and non-experienced *S*s on the

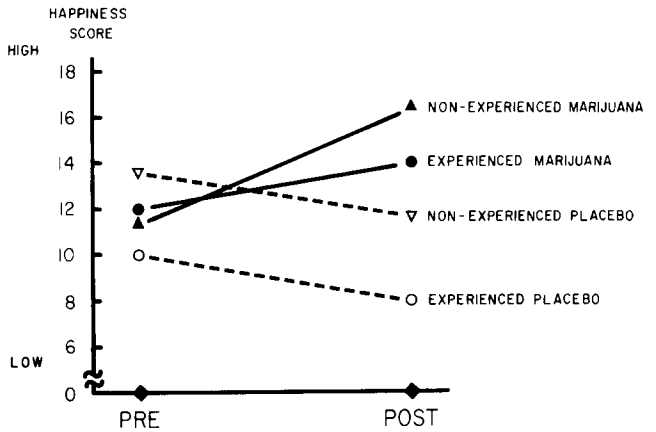


FIG. 2. Pre and post happiness scores for both the experienced and non-experienced groups.

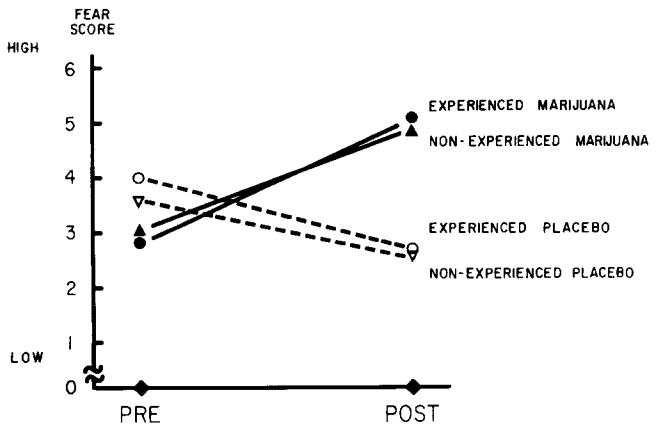


FIG. 3. Pre and post fear score for both the experienced and non-experienced groups.

rate of correct identification ($\chi^2 = 3.84$). As there was no difference in the rate of correct identification for the two groups, a one-tailed Binomial test was conducted on the combined correct identification rate. The test confirmed that the *S*s correctly identified the M condition significantly better than possible by chance ($p<0.05$).

## DISCUSSION

The results of these objective tests of skin sensitivity, which have been shown previously to be responsive to small changes in sensitivity [37] do not confirm the subjective report of cannabis users that smoking marijuana produces increased tactile sensitivity [32]. Our finding may also be contrary to the conclusion reached by Rodin *et al.* [28], who found that "vibratory sense appreciation had slightly improved in six of nine subjects." The association between vibratory sensitivity and touch sensitivity is not clear nor is it certain how vibratory sensitivity was measured. Moreover, their failure to use a placebo control condition and a standard dose of marijuana weakens any conclusion that can be drawn from their results. Only two studies have been carried out on the other sensory modalities. These studies by Caldwell *et al.* [2] and the Mayor's Commission [31] suggest that marijuana does not affect auditory or visual functioning. Although Caldwell *et al.* reported a change in auditory intensity threshold they also found no change in auditory and frequency thresholds or on visual brightness perception. This is consistent with the finding of the Mayor's Commission of no effect on auditory frequency discrimination.

In trying to understand fully this lack of change in sensitivity after smoking marijuana we re-examined our protocol to make certain that a sufficient dose was being administered. The results of the pilot study, the changes in happiness, the subjective state and post-hoc substance identification date, all confirm that 600 mg of marijuana was a sufficient dose and did produce a state of intoxication in both groups of *S*s. It is possible that changes in sensitivity are partially dependent on the amount of previous experience with cannabis. Further the possibility exists that cigarette smokers might inhale and retain more smoke than non-smokers of cigarettes thus receiving a higher effective dose. Either of these factors could have masked and confounded the results. In order to examine both possibilities, the correlations for the pressure, pain, two-point acuity and tactual fusion M difference scores with past cannabis use and with amount of tobacco usually consumed were calculated. These low correlations indicate little relationship between either of these measures and the dependent variables. Although the pilot study suggested that no relationship exists between body-weight and effective dosage, the correlations were also calculated between body-weight and the presmoking-postsmoking marijuana difference scores for the four above measures. Again, the low correlations support our pilot study observation that at this dose level and for these measures, no differential effects on these skin sensitivity measures exist as a function of body weight. It is possible that these correlations would be higher at higher doses and/or with different measures. The finding of Tart [32] that approximately 72% of users experienced changes in touch sensitivity after smoking marijuana is not supported by our data. His finding could possibly be explained by Weil *et al.*'s [34] hypothesis that "incoming sensory information . . . normally follows conditioned pathways through the secondary perception network in order to get to consciousness. Under cannabis, which might interfere with this normal processing, information may take novel routes to consciousness and thus be perceived in novel ways."

Our controlled double-blind data with respect to clinically observed intoxication is conflicting. The observations of the drug administrator and the verbal reports of the *S*s support the impression gleaned on the street, that marijuana is less intoxicating on initial use. However, this difference is not seen if a criterion such as the happiness or fear scale is used as an index of intoxication. These indices show statistical significant changes in affect of approximately the same amount for both experienced and non-experienced subjects.

The recent work of Casswell and Marks [5] which compares users and non-users is also conflicting and indicates a need for further study of the differences in effects between naive and experienced subjects. In their study, they examined the effects of 2 doses (3.3 and 6.6 mg $\Delta^9$-THC) of cannabis on 3 cognitive tasks in a naive and experienced group. They found a significant dose-related impairment in 2 tasks (goal directed serial alternation and serial substraction) but no significant difference between

naive and experienced subjects. There was no difference in performance on a third cognitive test (digit span). In addition to studying cognitive effects, they obtained reports on the subjective measures including ratings by the *S*s of the strength of the cigarettes smoked, the extent of its effect, and which if any of 14 symptoms or systems were affected. There was a significant dose effect on all three measures but no significant difference on any of the rating scales between the naive and the experienced subjects, "although there was a slight tendency in all three conditions for the experienced subjects to rate more variables as affected than naive subjects." This lack of a clear difference but trend toward greater subjective effects in the user group is also suggested by the results of our two studies reported here.

Our finding of an increase in fear in both the experienced and non-experienced subjects is puzzling as Abel [1] reports a decrease in anxiety as a result of smoking marijuana. Further study is necessary before any conclusions can be drawn regarding this finding of increased fear.

Several final comments must be made regarding our ability to generalize these results. The first point is in regard to the smoking procedure. When smoking marijuana, users hold the smoke in their lungs for some period prior to expiration. However, the subjects in this study were asked to breathe normally and not to hold their breath, in an attempt to minimize intra-subject variability in absorption which is partially a function of retention time. This procedure was generally successful but not every subject followed this instruction. Although this is not the usual way marijuana is smoked, our dose of 600 mg was selected, with this procedure, as producing the usual effect in experienced subjects. Therefore, we think that a generalization to a social situation is still valid. The second point refers to the reasons for having the subjects remain in the laboratory for 9 hr prior to smoking. As the anxiety produced by smoking marijuana in a strange surrounding with strange people could produce artifact, the subjects were allowed time to become comfortable with each other, the researchers, and the surroundings. Further this provided an opportunity to standardize pre-smoking activity as well as asymptote practice effects on the sensory tests. While confinement is not known to produce changes in sensory functions [37] it can cause changes in affect. This change most likely would be a decrease in happiness and an increase in depression. Therefore, it is unlikely that the reported increase in happiness is a result of a confound due to confinement. Our placebo data further indicate that this minor confinement did not produce any changes in sensory function or affect. In addition the majority of subjects appeared quite relaxed in the smoking situation.

In summary, the results from these two studies do not support the idea that marijuana produces changes in cutaneous sensitivity in either experienced or non-experienced subjects. Possibly reported sensory effects could be a result of charges in perception rather than changes in sensory experience. Furthermore, the failure to observe marked differences in subjective effects in the user and non-user groups suggests the need for further comparative study of these two groups using performance measures that are known to be sensitive to marijuana.

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