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# Motivation Levels and the Marihuana High

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A total of 112 volunteer males, aged 18–30 years, were randomly assigned to eight groups, with 14 subjects per group. For each of two drug conditions (no drug and marihuana), there were four motivation conditions. In the first motivation group, the subjects were merely given instructions concerning how to perform on each dependent measure. The second motivation group was given the additional instructions to "try as hard as possible" on each measure. The third motivation group could earn a small amount of money, contingent on the performance of the dependent measures. The fourth group could earn a substantial amount of money contingent upon task performance. Time perception, choice reaction time, and a paired-associate memory task were used as dependent measures. The results indicated a significant, detrimental drug effect on all measures and a significant motivation effect on the reaction time measure. Close examination of the data suggests that the drug effect occurred because of the ineffectiveness of the motivation manipulation with the marihuana subjects.

Much diversity of opinion surrounds the phenomenon of marihuana intoxication. There is presently little agreement among researchers on the effect of marihuana on behavior. For example, whereas some authors have found that marihuana impairs various coordination and cognitive skills (reviewed in LeDain, Campbell, Lehmann, Stein, & Bertrand, 1972) others have suggested that attentional factors and boredom might be producing these deficits (e.g., Manno, Kiplinger, Scholz, & Forney, 1971). Indeed, there is an increasing body of evidence to support the notion that extrapharmacological factors may play at least as great a role in marihuana intoxication as the drug itself. Expectancy and social setting (Adamec, 1976; Jones, 1971), sex of the subject (Adamec & Pihl, 1978); Carlin, Bakker, Halpern, & Post, 1972), and the presence of extraneous stimuli (Pihl, Spiers, & Shea, 1977) have all been shown to affect marihuana intoxication, particularly when social dosages are involved.

One of the clearest examples of the significance of extrapharmacological factors in marihuana intoxication is found in a study by Cappell and Pliner (1973). In this experiment, the subjects, when instructed to "try to be as accurate as possible," were able to reduce the effects of marihuana on a time estimation task. The present study was undertaken to determine whether several different levels of motivation would serve differentially to reduce the marihuana effect and to assess these potential effects on a broader range of measures. Dependent measures were employed that had already been shown to produce a reliable drug effect. Marihuana-induced deficits in time perception (e.g., Clark, Hughes, & Nakashima, 1970; Rossi, 1973; Vachon, Sulkowski, & Rich, 1974) and complex or choice reaction time (Clark et al., 1970; Kiplinger, Manno, Rodda, & Forney, 1971) have been relatively consistently reported. A third dependent measure, a paired-associate task, was chosen primarily on the basis of its previously demonstrated sensitivity to different levels of motivation (Pihl & Greenspoon, 1969).

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## Method

### *Subjects*

The subjects were 112 volunteer males, aged 18–30 years, who had responded to advertisements posted around the university campus and aired on a local radio station. The subjects had refrained from using any psychoactive drug for at least 24 hours prior to the experimental session.

### *Apparatus*

The room in which the subjects were tested was designed to approximate the appearance of an apartment. The decor consisted of hanging plants, a thick carpet, wall hangings, and soft lighting. Choice reaction time was measured to the nearest .01 sec by a Lafayette Multi Choice Reaction Timer. A memory drum presented nonsense syllables in the paired-associate task.

### *Procedure*

The subjects were randomly assigned to one of eight groups, 14 subjects per group. For each of four motivational conditions, there was a nondrug and a drug condition. In each session of any given condition, the subjects were run in pairs; each pair of subjects were friends.

Medical histories and legal consent forms were completed by the subjects in the drug condition. The room lighting was then reduced to a low level, and tape recorded music was played at a low volume. The subjects were provided with a roach clip (for smoking the short butt of the cigarettes), an ash tray, and an ample supply of drinking water. They were then presented with four cigarettes, each containing .5 g of marihuana at .8% THC content. The subjects were then instructed on how to smoke the marihuana cigarettes: Each cigarette was to be passed back and forth between the subjects; each subject was to inhale and hold the marihuana smoke as long as possible; and the subjects were to take alternate turns lighting each cigarette. Thus, each subject consumed approximately 1 g of marihuana containing .8% THC, or approximately 8 mg THC per subject. Although this smoking procedure did not permit precise control of THC intake, it was felt that any loss of accuracy was compensated for by the more natural smoking conditions resulting from the procedure of "passing the joint." Because such extrapharmacological factors as expectancy and social setting are an important aspect of the marihuana experience, oral ingestion of THC might have distorted the subjects' usual "high." Smoking proceeded continuously until all four marihuana cigarettes were consumed. This took approximately 20 minutes but varied slightly between sessions. An experimenter remained with the subjects during the smoking procedure to monitor their smoking behavior and to answer any questions. After 30 minutes, the music was turned off, the room light was increased to its normal level, and the subjects were tested on the various dependent measures.

The subjects in the non-drug condition were tested as soon as they had become comfortable in the experimental room. No music was played, and the room lighting was normal.

All subjects first performed the time perception task. The two subjects in each session performed this task simultaneously. The subjects were then told that following a warning, they would hear a taped segment of music. The subjects in the no-motivation condition were told merely that they would be required to estimate the duration, in seconds, of the passage. The verbal motivation group was instructed additionally to try to be as accurate as possible. The low-money group was informed that each subject would receive $1.00 for an estimation within 10 sec of the correct duration and an additional 10¢ for each second that their estimate came closer to the actual duration. The high-money group was promised $2.00 for estimating within 10 sec and 25¢ for each second of increased accuracy of estimation. The two subjects in each session listened to the music segment together. The time estimates were submitted separately and in writing, without consultation between subjects.

Following completion of the time perception measure, one subject was tested by an experimenter on the reaction time measure while the other subject performed the paired-associate task, which was administered by a second experimenter. The two subjects then switched tasks and were tested on the remaining dependent measure.

The choice reaction time apparatus consisted of three lights and two keys. One light was a rule light. When lit, it indicated correspondence between the other two lights and their respective keys; when extinguished, it indicated an inverse relationship between the lights and keys. The subjects were allowed to push the response keys only with the index finger of the dominant hand, and at the start of each trial, that index finger was located at a point equidistant from the two response keys. Each subject performed 15 trials, which had been predetermined in a random fashion. Reaction time was measured until the correct key was pushed, which caused the lights to turn off and the clock to stop. If a subject pressed the incorrect key, he had still to get to the correct key to complete the trial. An experimenter recorded the time and initiated each trial. The subjects in the no-motivation condition were merely given the above instructions. The verbal motivation group was further instructed to try to have the shortest possible reaction times (i.e., to be as fast as possible). The low- and high-money groups were paid according to how fast they responded. Each .1-sec reduction in reaction time below 2.2 sec brought a low-money subject 10¢ and a high-money subject 25¢.

In the paired-associate task, the subject was instructed to guess a number from 1 to 8 each time a nonsense syllable appeared in the viewing slot of a memory drum. The drum tape contained three dif-

Table 1
*Summary of Multivariate Analysis of Variance*

| Source of variation | *df* | *F* | *p* |
|---|---|---|---|
| Drug | 3,102 | 4.17 | .008 |
| Motivation | 9,248 | 1.75 | .079 |
| Drug × Motivation | 9,248 | 1.35 | .213 |

ferent orders of the same set of 8–0 association value nonsense syllables. The tape moved continuously, with each syllable appearing in the slot for 3 sec. The experimenters had predetermined what syllable went with what number. The experimenter said "Right!" each time a subject made a correct pairing, but no response was made to an incorrect pairing. The no-motivation group was given only the above instructions. The verbal motivation group was also told to try to make as many correct responses as possible. The subjects in the low-money group were informed that they would receive 10¢ for each correct response; the subjects in the high-money condition were told that they would receive 25¢ per correct response.

After completion of the three measures, all subjects were debriefed, and the subjects in the money conditions were paid according to their performance level. Typically, the subjects in the low-money group earned about $2.50, and the subjects in the high-money group earned about $5.00.

## Results

A multivariate analysis of variance was applied to the data after using a logarithmic transformation on the dependent variables. This was done to attempt to reduce the variance that became obvious in the univariate analyses of variance discussed below, and to attempt to correct for positive skewness in the data. The multivariate analysis of variance, which is summarized in Table 1, produced a significant drug effect, $F(3, 102) = 4.17$, $p < .008$. Although a significant interaction was not demonstrated in this analysis, histograms plotting the antilogs of the means look very similar to those plotted in Figures 1 through 3 and are highly suggestive of such an interaction. It would seem that an overall, large within-cell variance rather than outliers might be responsible for this. The univariate analyses of variance are discussed in detail below and summarized in Tables 2 and 3.

### *Time Perception*

Each subject's score on the time perception measure was calculated by taking the absolute value of difference between the subject's estimated time and the actual time of the music (50 sec).

A two-way analysis of variance was performed on this data and yielded significance only for the drug effect, $F(1, 104) = 4.75$, $p < .05$. The subjects in the drug condition were less accurate (mean absolute error = 19.8 sec) than the subjects in the nondrug condition (mean absolute error = 13 sec), with the direction of the inaccuracy toward overestimation, $t(110) = 2.79$, $p < .01$. Examination of

Table 2
*Summary of Analysis of Variance Results*

| Source of variation | *df* | *F* | *p* |
|---|---|---|---|
| Reaction time | | | |
| Drug | 1 | 4.07 | .044 |
| Motivation | 3 | 4.15 | .008 |
| Drug × Motivation | 3 | 1.48 | .224 |
| Paired-associate measure | | | |
| Drug | 1 | 9.86 | .002 |
| Motivation | 3 | 0.38 | .767 |
| Drug × Motivation | 3 | 1.85 | .142 |
| Time perception | | | |
| Drug | 1 | 4.75 | .030 |
| Motivation | 3 | 2.09 | .104 |
| Drug × Motivation | 3 | 1.72 | .167 |

Table 3
*Summary of Analysis of Variance Means*

| | Motivation | | | |
|---|---|---|---|---|
| Condition | No motivation | Verbal motivation | 10¢ | 25¢ |
| Reaction time | | | | |
| Nondrug | 1.28 | .92 | .92 | .11 |
| Drug | 1.20 | 1.11 | 1.16 | 1.04 |
| Paired-associate measure | | | | |
| Nondrug | 14.5 | 15.43 | 17.36 | 18.21 |
| Drug | 14.0 | 13.07 | 11.36 | 12.71 |
| Time perception | | | | |
| Nondrug | 17.42 | 10.21 | 13.93 | 10.42 |
| Drug | 16.21 | 21.07 | 30.07 | 11.71 |

Figure 1 would seem to suggest that significance ought to have been achieved for the motivation effect. The subjects, particularly those in the drug condition, fared considerably worse in the contingent low-money condition than in the verbal motivation or contingent high-money condition. The presence of substantial variability was thus suggested as a potential drug effect. Hartley's test of homogeneity of variance was therefore applied to the scores, and the results proved significant, $F_{max}(8, 13) = 18.78$, $p < .01$.

*Reaction Time*

The results from the reaction time test are presented in Figure 2. A two-way analysis of variance yielded both a significant drug effect, $F(1, 104) = 4.07$, $p < .05$, and a significant motivation effect, $F(3, 104) = 4.15$, $p < .01$. The subjects in the nondrug condition had lower mean reaction times than those in the drug condition (means = 1.01 and 1.13, respectively). The Newman-Keuls procedure showed that the subjects in the no-motivation group had significantly ($p < .05$) higher mean reaction times than those in the other motivation conditions. Hartley's test of homogeneity of variance was also significant for this measure, $F_{max}(8, 13) = 10.68$, $p < .01$.

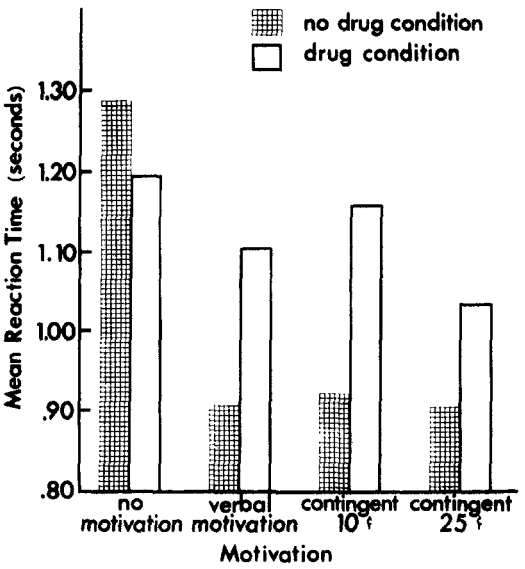


*Figure 2.* Mean scores for the drug and motivation groups on reaction time.

*Paired-Associate Task*

The results from the paired-associate measure are illustrated in Figure 3. A two-way

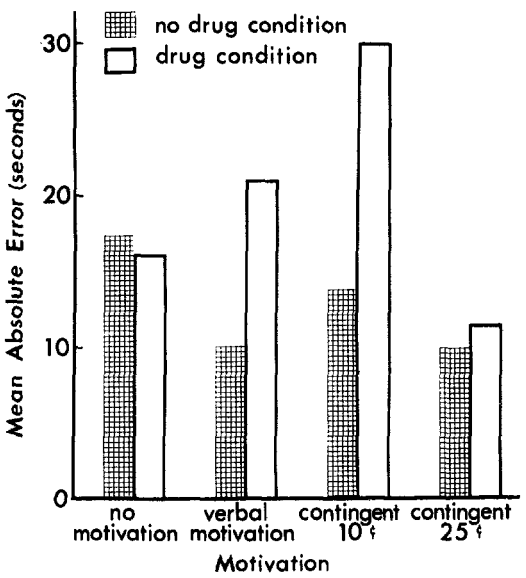


*Figure 1.* Mean scores for the drug and motivation groups on time estimation.

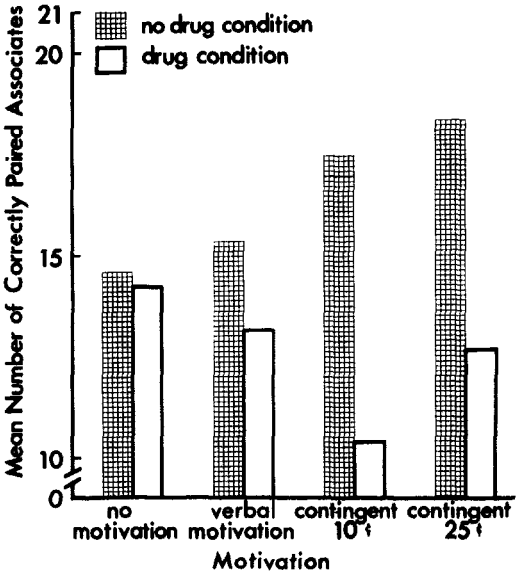


*Figure 3.* Mean scores for the drug and motivation groups on paired-associate learning.

analysis of variance yielded a significant drug effect, $F(1, 104) = 9.86$, $p < .01$, and a trend toward a Drug × Motivation interaction, $F(3, 111) = 1.85$, $p < .14$. The subjects in the nondrug condition were able to make significantly more correct associations (mean = 17.2) than those in the drug condition (mean = 12.8). No significant results were obtained on Hartley's measure of variability.

## Discussion

The results of this study do not replicate those of Cappell and Pliner (1973). They do, however, show a possible interaction between acute marihuana intoxication and motivation, and they do suggest the importance of considering individual and extrapharmacological factors in understanding the effects of intoxication. Although, because of procedural and dosage differences, the present study is not directly comparable to that of Cappell and Pliner (1973), it was nevertheless expected that the motivation manipulation would minimize drug effects. Of course, it is difficult to ameliorate an effect that has not occurred. Examination of Figures 1 through 3 reveals that a drug effect did not occur during the no-motivation condition. In fact, on two of the three measures, the marihuana subjects scored slightly better. The relatively low dosage used in this study might explain the absence of a "pure" drug effect. Nevertheless, the most consistent finding on each of the dependent measures across motivation conditions was a drug effect. Clearly, these findings are a function of what the motivation manipulations did or did not do to the subjects who smoked marihuana. Examination of Figures 1 through 3 reveals that the subjects in the nondrug condition improved as a function of motivation on all three measures, with significance occurring when the three motivation conditions are combined and compared to the no-motivation condition for the reaction time task, $T = 3.61$, $p < .01$. The subjects in the drug condition did not show significant changes as a result of motivation; they improved only slightly on reaction time but worsened on time estimation and paired-associate learning.

The ineffectiveness of the motivation manipulation with the marihuana subjects might be interpreted as supporting the notion of a marihuana-induced amotivational syndrome. Such a conclusion would appear hasty. This concept has generally been used to refer to a chronic effect of the drug (McGlothlin & West, 1968), and because of missing controls, the existence of this phenomenon is in doubt (LeDain et al., 1972). Further, before applying this value-laden concept to the acute situation, the generalizability of the apparent lack of response to incentive conditions seen in this study should be tested in various situations and with various measures where the motivation manipulations are more demanding.

Although explicit in the above discussion is the notion of a Drug × Motivation interaction, trend but not significant interactions were obtained in the overall analyses of variance. Like many marihuana studies, the presence of extreme variability of response was a modulating factor on statistical analyses. The factors that could be contributing to this variability include: (a) subjects trying extra hard to compensate for being "high" and reaching the upper end of the Yerkes-Dodson curve (too much tension leading to performance decrement and variability); (b) some subjects ignoring, or not understanding, the incentive conditions; (c) subjects receiving different amounts of marihuana because of differences in individual smoking habits; (d) the potential confounding effects because the drug subjects knew they had taken a psychoactive drug, had spent an additional 30-minute period of social relaxation in a darkened room with music, and were administered the measures by experimenters not blind to condition. In spite of these considerations, it is becoming more evident that what a person brings into the situation in terms of trait variables plays an important role in both general and drug-related behavior. Consequently, in understanding the effects of marihuana at low dosages, simplistic drug-yields-effect statements are not sufficient, and one must begin to study the interaction between organismic variables and extrapharmacological factors.

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