

The Effects of Alcohol, Marihuana and Their Combination on Driving Ability¹

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SUMMARY. The combination of marihuana and alcohol yielded significant impairment during a driving test but neither drug alone did.

DESPITE data (2) which indicate that many teenagers of driving age report use of marihuana and laboratory studies using driving simulators (3-7) which show significant impairment of skills essential for driving under the influence of marihuana, law-enforcement officials acknowledge the lack of attention to problems of youth who combine drinking, drugs and driving. The Director of the Allegheny County Bureau of Public Protection wrote: "Somehow, I think it was believed that if the problem were ignored, it would go away."² A possible reason for the lack of attention to this problem is the absence of definitive guidelines regarding the effects of different levels of marihuana and of alcohol-marihuana combinations on driving ability.

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² DANZILLI, J. [Personal communication, 1 June 1979.]

Prior to this study, there have been only a few on-road studies which examined the effect of marihuana on driving. One of those driving studies (8) compared marihuana intoxication with alcohol intoxication, but none examined the joint consumption of marihuana and alcohol.

This study was undertaken to examine the effects of varying levels of alcohol and marihuana consumption and their combined effect on driving performance. Driving performance was measured in a controlled obstacle course which closely paralleled actual driving situations.

METHOD

Subjects

Nine male volunteer subjects, all graduate students at the University of Pittsburgh, were selected on the basis of self-reports of at least weekly use of alcohol and marihuana, and of having driven under the influence of both drugs. Subjects were matched in terms of driving ability (mean, seven years' experience), age (mean, 25.1), weight (mean, 164.7 lb) and health (blood pressure and pulse within normal range, absence of allergic reaction to medication and normal electrocardiogram).

Measures

Drug Levels. Blood alcohol concentration (BAC) and serum tetrahydrocannabinol (THC) level were drawn to verify levels of the drugs. Serum samples were drawn approximately 45 min after alcohol consumption and 15 min after marihuana consumption based on prior research experience showing that these time periods coincide with peak blood concentration of the two drugs.

Driving Performance. Driving performance was measured in two ways. The first was an evaluation of driving performance using Pennsylvania motor vehicle code Title 67, Chapter 153—Driver Examination Statutes. This evaluation was made independently by a safety manager from the American Automobile Association and by a high-school driver-education instructor. The second performance measure was an evaluation made by an off-duty patrol officer who followed each driver on the obstacle course in an unmarked automobile. The officer attempted to determine whether the driver was impaired enough to warrant his being stopped for further investigation. His evaluation criteria included: traffic violations, speed (used to show cautiousness or aggressiveness), slow or quick starting or stopping, weaving over the yellow center line, hugging the yellow center line, and leaving the driving course (Figure 1).

Self-Reports of Feeling "High." Self-reports of feeling "high," using a scale from 1 (not being high,) to 10 (being the highest they had ever been), were collected from the subjects prior to their driving under the influence of the drugs.

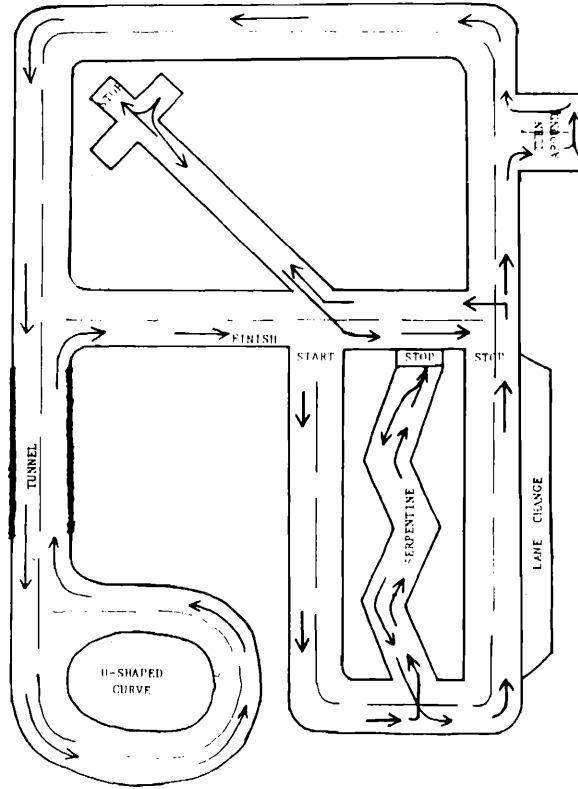


FIGURE 1.—*Experimental Driving Course Used by Subjects*

Procedure

Subjects were randomly assigned to one of four experimental groups. A repeated-measures design was used so that all subjects participated in each experimental condition.

Urine samples were taken from each subject at the beginning of each session to rule out the possibility that a drug other than those introduced during the study was responsible for driving impairment. Pulse rates were monitored before drugs were given and again after each experimental condition was completed.

Driving trials were conducted over a four-day period. During the first day, subjects were trained on the obstacle course through the use of a dual-controlled automobile. Subjects practiced until they were able to complete each maneuver in the course without error (mean, three trials). On each of the three following days, subjects completed the course one time as a reorientation measure prior to receiving any drug. Following practice trials each day, pulse rates were taken and subjects were then

given alcohol (either a placebo or enough vodka to approximate a .06% BAC) and marihuana (either a placebo or 2% D-9-THC). To ensure that they were not aware of their conditions, all subjects received an equal amount of beverage (three glasses), and the placebo drinks were "misted" with a small quantity of vodka to create an odor of alcohol. The marihuana placebo consisted of a marihuana cigarette detoxified of all THC.³ To achieve peak intoxication for both drugs simultaneously, subjects were given the marihuana-like cigarette 25 min after ingesting the desired alcohol dosage. The subjects were required to smoke the entire cigarette with cycles of inhaling, holding the smoke in the lungs for 15 sec and then exhaling (9). Two blood samples were drawn approximately 45 min after the subjects stopped drinking. It was at this time that the subjects were asked to rate how high they thought they were. Subjects then entered the dual-controlled automobiles with a driving instructor. The driving instructor answered any questions posed by the subject and then instructed the subject to drive through the obstacle course.

RESULTS

A one-way analysis of variance (ANOVA) to evaluate the effects of alcohol and marihuana on driving performance, as rated by the driving instructors, yielded a significant effect under the combination condition ($F = 4.00$, 3 df, $p < .05$). Neither alcohol alone nor marihuana alone resulted in significantly poorer driving performance when compared with the same subjects' performance under the placebo state.

A one-way ANOVA to compare the patrol officers' evaluation of driving impairment across the four conditions yielded a significant effect for the combination condition ($F = 11.70$, 3 df, $p < .01$). Using Scheffé post-hoc comparison, significant impairment was noted for the combination condition but not for the alcohol or marihuana conditions. The patrol officer indicated that he would have stopped drivers in a total of 15 trials, including all those in the combination condition. According to this measure, therefore, neither marihuana alone nor alcohol alone at the levels used in this study impaired driving performance to a significant degree, but use of both drugs simultaneously resulted in significant driving impairment.

Pulse rates taken before drug use and at the conclusion of driving were compared with a one-way ANOVA; significant differences were noted ($F = 34.62$, $p < .01$). A Scheffé post-hoc comparison showed the marihuana and combination conditions to be associated with

³ Supplied by the National Institute on Drug Abuse.

significant increases in pulse rates ($p < .01$). The alcohol and placebo conditions were not significantly different from each other, nor were the combination and marihuana conditions. Mean increases in beats per minute were as follows: placebo, 6.89; alcohol, 9.22; marihuana, 35.67; combination, 38.78.

Subjects' ratings of feeling "high" were compared by a one-way ANOVA, yielding a significant overall effect ($F = 59.61$, $p < .01$). A post-hoc Scheffé comparison showed that subjects rated themselves as significantly more "high" in the combination and marihuana conditions than when under the placebo or alcohol conditions ($p < .01$). The alcohol condition resulted in a significantly greater "high" feeling than the placebo condition ($p < .05$). Mean ratings for each condition were as follows: placebo, 1.44; alcohol, 3.78; marihuana, 7.56; combination, 8.89.

DISCUSSION

The combination of marihuana and alcohol, even at low levels of the drugs, proved to have a potentially dangerous effect on the driving task. The impairment created by the combination of the two drugs was much greater than that created by either drug separately.

The most practical dependent variable was the blinded evaluation of the patrol officer. It was most practical because this type of evaluation is used every day in the apprehension of alcohol-intoxicated drivers by patrol officers. The patrol officer stopped every driver under the combination condition. This is an important result with rather serious implications. The most serious implication is that, at the present time, Pennsylvania and almost every other state have no way of detecting or prosecuting drivers under this condition, because there is no simple or practical way to detect or measure marihuana intoxication. Under the conditions in this study, all drivers in the state of Pennsylvania, barring a traffic accident or fatality, would be cited with only a minor charge because their BACS would be significantly lower than the legal criterion for intoxication (.10%).

Marihuana alone did not significantly impair driving performance as measured in this study. This result is puzzling because of the elaborate efforts made in this study to maximize marihuana intoxication (9). Klonoff (10) and Le Dain (8) found serious impairment when marihuana was given at a dosage similar to that used in this study. Driving-simulator studies (3-7) found impair-

ment on numerous skills essential for driving at this level of intoxication. It is imperative to include maneuvers testing perception and attention in any study examining the effects of marihuana intoxication on driving performance. Unfortunately, the course used in the current study had very few such maneuvers and subjects consequently showed very little driving impairment under the influence of marihuana. Another reason that so little impairment was visible on the course may have been the experience of the subjects in the use of marihuana. Each subject smoked marihuana at least once a week and had driven an automobile on at least one occasion under the influence of marihuana. The results of the study would most likely have been different if subjects naive to marihuana use had been used.

The subjects used in this study were good representatives of the population that consumes marihuana and alcohol socially—they were relatively young and were often in situations where smoking marihuana and consuming alcohol are socially acceptable, e.g., at parties. As reported by Small and Rush (2), the age range of 20–34 reports the highest use of both marihuana and alcohol.

Because of the high potency of the drugs used, most subjects indicated that they could tell when they were smoking marihuana after only a few “hits” from the cigarettes. In other words, the usefulness of the placebo cigarettes was greatly limited and all future experiments must consider this. Effective ways of eliminating this problem in the future would be to use different subjects in each condition rather than repeating the same subjects through all conditions, or to have two marihuana conditions in addition to the placebo condition. For the most part, subjects indicated that the alcohol placebo was an adequate disguise.

The subjects also made several useful comments about the off-road course. Many of the subjects stated that they were too intoxicated to drive (in fact, some had difficulty walking to the automobiles), but once in the automobiles they stated that they “crawled” through the course at a much slower speed than in the training exercises in order to compensate for their intoxication. The subjects indicated that the most difficult parts of the course were the U-shaped curve, the tunnels and the “T” exercise. A few stated that they had to force themselves to keep their attention on the course. Many of the subjects stated that they had made a great effort to drive the best they could, apparently in an effort to show that the drug had no effect on their driving.

Of particular interest was the impairment demonstrated under the combination condition, which suggested a synergistic reaction between the two drugs. This would make the task of operating a motor vehicle much more difficult and dangerous, particularly for youth. In a recent survey⁴ which examined marihuana and alcohol use and attitudes toward driving, high-school-aged students showed a high use of both drugs combined. Some even stated that, contrary to existing literature, the drugs acted in an antagonistic manner, thereby making the driving task easier. It is imperative that educators and psychologists properly educate this more vulnerable segment of our society.

The current research demonstrated a serious interaction effect between alcohol and marihuana and driving performance. With the growing combined use of alcohol and marihuana,^{2,4} future research must be designed to examine the role of this combination on the operation of motor vehicles. Future research must (1) investigate further the effects of marihuana intoxication on driving performance using actual road studies, (2) investigate the combined effect of marihuana and alcohol on driving performance using actual road studies and driving simulators, and (3) develop legislation concerning marihuana intoxication while driving.

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