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THE STUDY OF POSSIBLE INFLUENCES OF LICIT AND ILLICIT DRUGS ON DRIVER BEHAVIOR

Institute for Research in Public Safety
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16. Abstract

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THE STUDY OF POSSIBLE INFLUENCES OF LICIT AND ILLICIT DRUGS ON DRIVER BEHAVIOR

PREFACE

A study was conducted to investigate the possible relationship between psychotropic drug usage and motor vehicle accidents in a college student population. Data were developed to:

1. Measure the incidence of drug presence in the blood among college student drivers just involved in a motor vehicle accident (experimental or E group).

2. Measure the incidence of drug presence in the blood among a population selected to approximate college student drivers on the road at the same time as those just involved in a motor vehicle accident (control or C group).

3. Identify and describe drug use patterns among the college student population.

4. Measure relationships between motor vehicle accidents, drug usage, and other factors.

The blood tests of the E group subjects indicated that two of the 24 college student drivers tested had psychotropic (i.e., behavior altering) drugs in their blood shortly after the occurrence of a motor vehicle accident. The tests showed the probable presence of morphine in the blood of one of the subjects and the probable presence of protriptyline (an antidepressant) in the blood of another subject. It was the opinion of the researcher who interviewed the subjects that neither drug was taken illicitly.

The blood tests of C group subjects indicated that five out of 54 college students tested had psychotropic drugs in their blood. Four of these five were found to have secobarbital in their blood. The fifth subject tested positive for morphine and was believed to be the only one who had taken the indicated

drug illicitly.

Statistically, the data from E and C groups may be interpreted to mean that the probability is quite high (i.e., greater than .75) that drug presence in the blood occurs with equal frequency among college student drivers involved in motor vehicle accidents and college students not involved in motor vehicle accidents.

Data gathered through interviews with subjects from both E and C groups showed a general reluctance of these students to drive at all while under the influence of drugs. Those who claimed they had driven under the effect of marijuana usually admitted some impairment, but said they drove more carefully to compensate for it. Users of psychedelics seemed even less likely to drive while under the effects of drugs, but reported that when "forced" to drive, their impairment was usually severe. Those claiming to have driven under the influence of amphetamines reported increased speed and aggressiveness on the highway.

The general pattern of illicit drug usage among college students interviewed was one of light to moderate use of marijuana (i.e., less than a few times a month) with no or very slight experience with psychedelics. Seventy percent of all subjects said they had used illicit drugs, but 25 percent of the subjects had used only marijuana. About 70 percent of all subjects said they had used licit psychotropic drugs, more commonly antihistamines and pain medicines. Use of opiates was rare (less than five percent), with only one subject out of 107 interviewed claiming to be a heroin user.

By far the best predictor of total motor vehicle accidents among the students was total traffic law moving violations (pairwise correlation coefficient equal to .59). Thus, knowledge of a student's traffic law violation history provided a very good basis for estimating the total number of motor vehicle accidents he had had. In contrast, no drug-usage, demographic or psychological variable predicted total motor vehicle accidents with any acceptable degree of accuracy.

1.0 INTRODUCTION

This is the final report of a study designed to investigate the possible relationship between drug usage and motor vehicle accidents in a college-student population. The study deals with the use of both licit and illicit drugs, but is limited to those drugs which are capable of causing behavioral changes (i.e., psychotropic drugs). The study was carried out by the Indiana University Institute for Research in Public Safety (IRPS) as a part of a larger effort to investigate factors related to motor vehicle accidents. This entire research effort, including the present study, is sponsored by the National Highway Traffic Safety Administration of the U. S. Department of Transportation under contract FH-11-7244-S.

The report is presented in six major sections: Introduction, Methods and Procedures, Results, Conclusions, Recommendations, and (as Appendix A) a Literature Review.

The research reported herein was conducted from 1 January, 1971 to 31 August, 1971.

1.1 General Objective

The objective of the study was to determine whether the use of licit or illicit drugs plays a role in motor-vehicle accidents involving college-student drivers. Conclusions were to be based upon data derived from:

1. Analysis of blood specimens for the presence of drugs.
2. Interviews with subjects concerning their driving histories.
3. Interviews with subjects concerning their histories of drug use.

1.2 Specific Objectives

The specific objectives of the study were to:

1. Obtain and analyze blood specimens from a sample of college-student drivers involved in motor vehicle accidents to determine the possible presence of licit or illicit drugs.
2. Obtain and analyze blood specimens from a sample of

college students not involved in motor vehicle accidents to determine the possible presence of licit or illicit drugs.

3. Interview the tested drivers regarding their driving histories, their use of drugs, and other factors that might be relevant to motor vehicle accidents.

4. Estimate the role of drug usage in the accidents involving these subjects.

5. Test the feasibility and validity to the problem of drug usage and driving of the outlined research method.

6. Circumferentially describe the socio-cultural and psychological factors related to drug usage amongst the sample population.

7. Determine the existence or absence of identifiable patterns in the type and degree of drug usage amongst the sample population.

1.3 Background

The use of psychotropic drugs -- whether licit or illicit -- has become so widespread amongst both the general population and the college-student population as to make it important to determine whether the use of these drugs is a significant factor in automobile accidents.

The consumption of over-the-counter preparations containing antihistamines, for instance, is rapidly increasing. So is the consumption of both major and minor tranquillizers, given routinely by presecription. These common drugs may all cause drowsiness, and users are therefore cautioned against driving while under their influence. Some preparations have sedative effects lasting up to 24 hours ("Health, Medical, and Drug Factors in Highway Safety," Publications No. 328, National Academy of Sciences -- National Research Council, Washington, D. C., 1954), yet many people use these preparations either on a short-term basis or regularly. The effects on their operation of motor vehicles are unknown.

Similarly, the use of illicit psychotropic drugs is increasing especially amongst the college-student population. Abelson in 1968 estimated that 30 to 35 percent of students at major universities on the East and West Coasts had used marijuana at least once. Other

studies have estimated as high as 50 percent of the students at most large universities and at small colleges outside the South. Estimates of the use by college students of hallucinogens and amphetamines are difficult and unreliable, but they are currently in the range of five to 20 percent -- though most students seem to use the drugs only once or twice. Usage is certainly high enough to suggest at least its occasional combination with driving.

There has been little scientific study of the relationship between drug use and traffic accidents (with the exception of alcohol). For instance, the effects of amphetamine abuse by truck drivers have been measured (Fort, 1964), but this is a problem of chronic use to fight off fatigue, and the effects on driving might be noticeably different in the case of acute usage to produce a "high." Again, there are reports that marijuana influences both visual acuity and psychomotor and coordination tests. According to McFarland and Moore (1951), however, the correlation between visual acuity and accidents is only 0.04, and correlations between psychomotor and coordination tests and accidents range from 0.0 to 0.11. There is thus no valid indirect evidence that marijuana will influence accident rates.

Most of the studies on the relationship between drug use and traffic accidents merely report uncontrolled, and sometimes anecdotal, findings. Recently, indeed, Waller (1971) reviewed the available literature and concluded that the evidence for any link between drug use and motor vehicle accidents was at best tenuous.

The gaps in scientific knowledge seem to have been caused primarily by the following factors:

1. The absence of adequate toxicological tests.

2. The difficulty of obtaining volunteer blood specimens.

3. Igonorance about the interaction of one drug with another (existing studies concentrate on a few selected compounds).

4. Failure to obtain a control population which would allow for comparison of such variables as age, background, and education.

5. The absence of scientific clinical evaluations of the "normal" behavioral effects of most compounds.

Thus current knowledge of the relationship between drugs and driving performance is very limited. Since college students belong to an age group with a particularly high accident rate and to a social group suspected of having a high drug use rate, increased knowledge concerning any relationship between their use of drugs and their driving performance would be particularly desirable.

1.4 Scope and Approach

The focus of this study was the driving and drug use of a group of Indiana University students, some of whom had just been involved in motor vehicle accidents. Drug use was determined by (a) interviewing all subjects as to what drugs they used, what effects they had felt, and whether they had ever experienced any of these effects while driving; and (b) analyzing blood specimens from all subjects to detect the presence of drugs. In the case of the drivers who had just had accidents, the blood specimen was taken immediately after the accident. The data so gathered provided the basis of the study.

A central principle of the study was the use of a control group, to approximate students not involved in motor vehicle accidents and who were driving at the same times as the accident-involved students. This was necessary because in the age group studied there is already an abnormally high level of accidents stemming from such psychological factors as immaturity, inexperience, and general life style. (In addition, certain demographic factors such as marital status and grade point average show a relationship to accident history.) The creation of a control group was therefore necessary to avoid falsely attributing to drug use accidents which might really be due to other causes. It was also hoped that additional data being collected through detailed investigation of motor vehicle accidents in the vicinity of the Indiana University campus (i.e., Monroe County, Indiana) would provide a further basis for determining whether drug usage was a causal factor in the accidents. The detailed investigations were performed as a part of a larger IRPS effort conducted under the same contract and were concerned primarily with the identification of the role of vehicle defects as causal factors in motor vehicle accidents.

It was thus possible to determine whether those drivers just

involved in an accident (i.e., the experimental group) differed significantly from the general student driving population (i.e., the control group) in regard to the presence of drugs in the blood. If it turned out that there was a significant difference, then the two groups could be examined further to identify any other significant differences that might exist. Thus, the relationship of drug presence and other factors could be analyzed. In addition, the entire sample population was analyzed to identify possible relationships between all accidents, drug usage, and other factors.

The study also examined the pertinent scientific literature. The information thus generated was of only tangential use to the present study, but it is included as an appendix to the report, with a commentary as to limitations and difficulties in the research which have been revealed by comparative analysis.

As was noted previously, a specific study objective was to investigate the feasibility of the research method for analyzing the relationship between drugs and motor vehicle accidents. Thus, in addition to providing a limited amount of data for a present analysis, the study may be viewed as a pilot study to test a methodology for a later, more meaningful application to a much larger group of subjects.

2.0 METHODS AND PROCEDURE

2.1 Overview

The main focus of the project was on investigating drug usage as a possible causal factor in motor vehicle accidents. A group consisting of college-student drivers who had just been involved in motor vehicle accidents was tested to determine the presence of drugs in the blood at the time of the accident. The incidence of drug presence in this group was then compared to that in a second or control group, who had not been involved in accidents, but who were chosen to approximate the student driving population on the road during the same time periods as the first group. Thus, a mechanism was created to investigate statistically whether drug usage was over-represented in the accident-involved segment of the total student population driving at given times.

The next step in the study was dependent upon the results of the comparative survey just described. If it turned out that a significant difference existed between the two groups then they would be analyzed further to determine the extent to which a control group had in fact, been achieved. Such an analysis would consider demographic factors, driving history, drug usage patterns, and personality characteristics, and would also attempt to identify any other relevant factors which might exist in different degrees in the two groups.

If, on the other hand, it turned out that there was no significant difference between the two groups in regard to drug usage while driving, then further comparisons between the two groups would not be required. In this case, it would be more meaningful to combine the two groups into a single group which could then be probed further to identify any significant relationships between the variables, particularly those describing motor vehicle accident history and drug usage history. It was decided, in fact, that regardless of the outcome of the comparative survey, this latter analysis would be conducted in order to obtain maximum utilization of the data.

Figure 2-1 illustrates how the above research concept was implemented. The accident-involved drivers were defined as the experimental (E) group and were selected from college students who had motor vehicle accidents within the period of the study. Ideally, the control (C) group would be chosen from college students driving motor vehicles during the time periods the E-group subjects were being involved in accidents. Roadside testing of

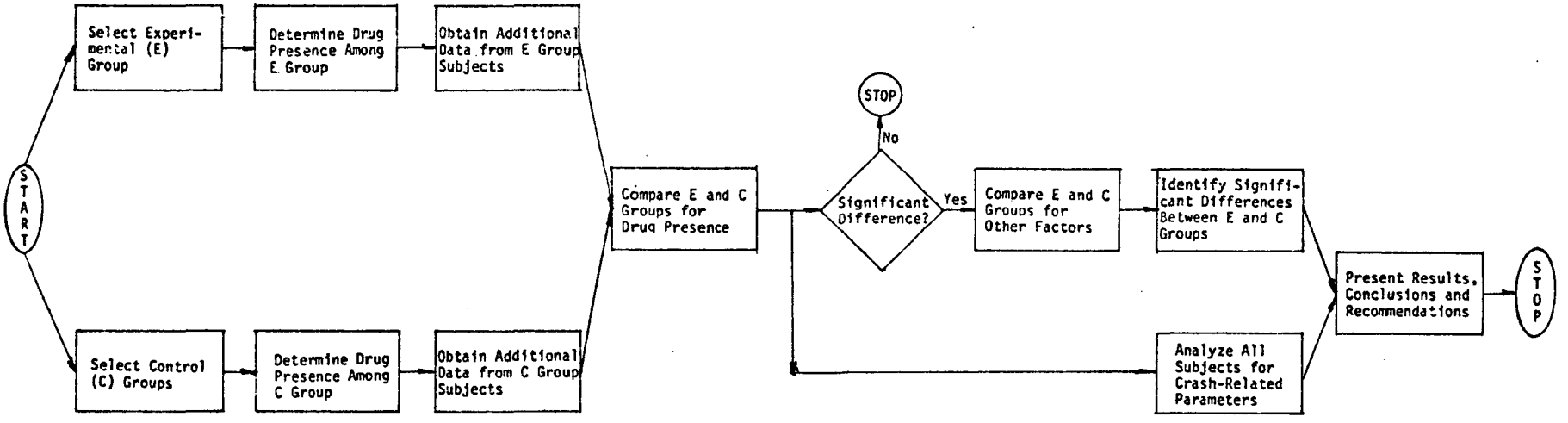

FIGURE 2-1
Study Methodology

student drivers would, in theory, appear to be a desirable way of collecting C-group data, but this approach was not feasible in the present study because the inherent attendant technical problems were not amenable to solution within the study level of effort. Instead, three alternate control groups were constructed from the student population in an attempt to approximate the desired control group. The composition of these control groups and the procedures used in selecting them are described in detail in Section 2.2. Blood serum tests (to determine drug presence) and interviews were then conducted within E- and C-groups to obtain the required data. The data collecting continued over the time period of January, 1971, to May, 1971.

The first step in the analysis phase was to compare the E-group with the C-groups to determine if there were any significant differences in regard to drug presence as indicated by the blood serum tests. A positive finding was to be followed by further comparisons and identification of other possible differences between the two groups. Meanwhile, the analysis of all subjects as a single group proceeded in an effort to identify other significant relationships between the pertinent study variables.

Finally, all results were assembled and presented, and used as a basis for the development of study conclusions and recommendations.

The following paragraphs provide more detailed descriptions of the important elements of the study methodology.

2.2 Selection of Subjects

The experimental group, as well as each of the control groups, was selected from Indiana University students aged 17 to 24 years who met the more specific criteria outlined for each group. This age range is chosen primarily because it encompasses virtually all undergraduates and the majority of all college students. In addition, impulse expression in driving, which occurs most often in young people, has been measured for this particular age group by Pelz and Schuman (45).

Specific subjects for the experimental group (E group) and the Control I group (C-I) were selected as follows: The first two motor vehicle accident victims (potential E subjects) and the first two non-motor vehicle accident (potential C-I subjects) victims who came to the Student Health Center (or Bloomington

Hospital) for treatment within each 12-hour period, and who agreed to participate, were chosen. The 12-hour periods were defined as from 9 a.m. to 9 p.m. and 9 p.m. to 9 a.m., seven days a week. (Both facilities are staffed 24 hours a day, seven days a week.)

The limitation of two of each type of accidents per each 12-hour period was decided for convenience of the Student Health Center staff and to avoid introducing bias from a single factor causing many accidents. Examples of the latter would be icy roads contributing to the incidence of many minor traffic accidents, or an intramural sports contest contributing to the incidence of injuries. Past experience indicated that this rate of acquisition would include most of the accidents that occurred.

Control Group II (C-II) was randomly chosen from patients admitted to the Student Health Center infirmary, excluding psychiatric, drug toxicity, or foreign patients. Subjects were acquired at approximately the same rate as subjects for the E and C-I groups. The selection process was spread over several months, since there were many days when there were no auto accidents.

Control group III (C-III) subjects were chosen from students who were in good health, but were obliged to come to the Student Health Center for either of two major reasons. A University regulation requires all students to have a physical examination on file at the Student Health Center before allowed to register. This group includes all ages, not just transfer students and incoming freshmen. By its nature, this group exists only at the beginning of each semester. A second group is composed of students who come to the Student Center to obtain a premarital serology test as required by state law.

Procedurally, whenever a potential E or C-I subject was brought into the Student Health Center, the emergency room nurse notified the on-duty laboratory technician, who is available 24 hours a day. After the student had been treated, the technician approached the student, briefly explained the nature and purpose of the study, and inquired if he wished to participate. Those who did were asked to sign an *Informed Consent* permit, after which a blood specimen was drawn. The subject was then told he would be contacted within a few days to complete the study. A similar procedure was followed in obtaining subjects for C-II and C-III, except that the technician was responsible for choosing the potential subjects according to a randomizing procedures. The

technician was instructed to approach the subjects in a standardized fashion. In accordance with University policy, he fully disclosed all aspects of the study procedures to the subject. He also assured the subject of the complete confidentiality of his responses.

2.3 Interviews and Psychological Tests

Within 24 hours the chief interviewer contacted the subject and arranged a mutually acceptable time and place for the interview and testing. The following types of information were obtained:

1. Selected demographic data including socio-economic and academic career status
2. Test for presence or absence of alcoholism (MAST)
3. Personality profile test (PRF)
4. Test of impulse expression likelihood in driving (Pelz-Schuman)
5. Driving experience and motor vehicle accident history
6. History of licit and illicit drug use.

The last two factors were the direct concern of the study. The interview concerned itself with any use of boty licit and illicit drugs. Particular emphasis was placed on the use of drugs while driving, effects or influences such drugs actually had on driving, any effects or influences the subject felt might have an influence on driving. The average time required for the interview was two to two and one-half hours.

Upon meeting the subject, the chief interviewer again explained the purpose of the study, reassured confidentiality, and pointed out that all information about a subject was assigned an identification number, with the subject's name being removed from all records. An in-depth, open-ended and informal interview was then conducted. Sample interview forms are included in the Appendices. Following the interview, three behavioral tests were administered. They are described subsequently.

2.3.1 The Michigan Alcoholism Screening Test (MAST)

The Michigan Alcoholism Screening Test (MAST) was devised by Melvin L. Selzer, M.D., to provide a consistent, quantifiable

structured interview instrument for the detection of alcoholism. It consists of 25 questions which can be rapidly administered by nonprofessional as well as professional personnel. A score of five or more points is considered presumptive of alcoholism.

2.3.2 The Impulse Expression Scale

Since 1966, D. C. Pelz and S. H. Schuman have investigated the driving behavior of young men ages 16 to 24 years. These drivers have strong assets for good driving -- sharp senses, keen reflexes, automotive knowledge, and recent driver training. Nevertheless, the death rate among these drivers is more than twice that for drivers 30 to 50. In a Michigan study of 100,000 drivers whose licenses were jeopardized because of excessive accidents and violations, more than half were between 18 and 24 years of age.

From questionnaires and interview, Pelz and Schuman have identified many of the liabilities of young drivers which more than counteract their assets. Of particular importance is the psychological need of many such drivers to discharge feelings of frustration and anger through their driving. Often this is done impulsively.

Much of the research done by these workers has advanced to the point where clear correlations can be shown between number of accidents and violations, and positive answers to certain questions on their questionnaires. These selected questions are utilized as a shortened and modified Impulse Expression Scale which attempts to measure the amount of "impulse expression" occurring in the drivers studied. It should be clearly noted that this modification was carried out by IRPS investigators. Although the IRPS is confident this is a valid and useful modification, any errors which might arise because of this modification are, of course, the responsibility of the IRPS and not of Drs. Pelz and Schuman.

2.3.3 The Personality Research Form (PRF)

The Personality Research Form (PRF) was developed by Douglas N. Jackson, Ph.D., and is available from Research Psychologists Press, Inc., Goshen, New York. It consists of a set of scores measuring 15 personality traits which are broadly relevant to the functioning of an individual in a wide variety of situations. It is concerned with describing the normal personality.

Both theoretically and in measurement terms, the scores are bipolar. Thus both high and low scores signal the presence of a character trait which distinguishes the subject from others. An example is the "Exhibition" dimension. One extreme is represented by a positive need to be conspicious, dramatic, and colorful. At the other extreme is both the absence of these traits, and the presence of fearfulness and an avoidance of appearing before groups.

The scales may be grouped according to general categories of traits. There are measurements of Impulse Expression and Control, Orientation towards Work and Play, Orientation towards Direction from Other People, Intellectual and Aesthetic Orientation, Degree of Ascendancy, Degree and Quality of Interpersonal Orientation, and of Test Taking Attitudes and Validity.

2.4 Blood Analysis

Blood tests were conducted to determine the presence of certain psychotropic drugs (see list in paragraph 2.4.3). No tests for ethanol were performed.

After being drawn in unheparinized tubes, the blood was allowed to clot, centrifuged, and the serum removed. It was then stored in a freezer at the Student Health Center. The samples were transferred weekly to the Department of Pharmacology laboratories and stored at -10°C. until tested.

Briefly, the method of identification may be described as follows. One ml. aliquots of each serum sample were added to tubes containing:

4 ml. Buffer	at	pH	+	5 ml. Solvent
citrate		2.2		chloroform
borate		9.3		chloroform isopropanol (3:1)
carbonate		11.0		chloroform

The tubes were shaken briefly by hand then centrifuged. The aqueous phases were removed, and the solvent phase evaporated in a water bath. The residue was dissolved in 0.05 - 0.1 ml. of methanol. The sample solution was then applied to glass fiber chromatographic sheets impregnated with silica gel (Gelman ITLC media). Spotting was accomplished with a Gelman application guide and disposable pipettes. The sheets were dried, placed

in developing tanks and developed with the appropriate solvent. Some typical solvents used, and the Rf values for drug standards, are listed below. Visualization was accomplished with UV light (254 and 350 millimicrons) and a variety of reagents.

2.4.1 TLC Developing Systems

I.	chloroform:methanol	98.2
II.	chloroform:methanol	95:2
III.	benzene:acetic acid:ethanol	95:10:5
IV.	benzene:acetic acid	98:2

2.4.2 Visualization Systems

i. UV light 350 millimicrons

ii. Iodine vapor

iii. $KMnO_4$ spray

iv. $HgNO_3$ spray

colors: BL = blue
BR = brown
GR = green
O = orange
PN = pink
R = red
WH = white
Y = yellow

2.4.3 Typical Rf Values *, + and Visualization Characteristics

Compound	Developing Solvent				Visualization			
	I	II	III	IV	i	ii	iii	iv
Amitriptyline*	56	85	69	-	-	BR	R/Y	-
Amobarbital+	97	-	-	96	-	-	WH	WH
Amphetamine*	19	48	90	-	-	BR	-	-
Chlordiazepoxide*	140	137	86	-	BL	BR	WH/Y	-

Chlorpromazine*	100	100	100	-	GR	BR	R/Y	PN/O
Cocaine*	116	96	6	-	-	BR	-	-
Diazepam+	103	-	-	82	BL	BR	-	WH
Glutelhimide+	104	-	-	115	-	BR	-	WH
LSD*	119	137	21	-	BL	-	-	-
Meperidine*	63	93	64	-	-	BR	-	-
Meprobamate*	193	116	118	-	-	BR	-	-
Mesaline*	33	37	39	-	-	BR	Y	-
Methadone*	81	93	50	-	-	BR	PN	-
Methamphetamine*	28	58	67	-	-	BR	-	-
Methylphenidate*	125	116	100	-	-	BR	Y	-
Morphine*	12	21	9	-	BL	BR	Y	-
Nortriptyline*	33	78	106	-	-	BR	R/Y	-
Pentobarbital+	97	-	-	93	-	-	W	W
Propoxyphene*	70	101	69	-	-	BR	-	-
Protriptyline*	23	62	100	-	BL	BR	R/Y	-
Quinine*	86	90	43	-	BL	BR	Y	-
Secobarbital+	100	-	-	100	-	BR	Y/W	W

*Rf relative to chlorpromazine
+Ff relative to secobarbital

2.5 Statistical Methodology

The results of the comparative survey to determine drug presence in the blood of students just involved in motor vehicle accidents relative to students not involved in motor vehicle accidents were evaluated using the chi-square test. A value of chi-square was computed from the blood test data collected

from the E and C groups. The statistical significance of any difference between the two groups in respect to drug presence in the blood was then determined from the chi-square distribution. In addition, 95 percent confidence intervals were determined from the binominal distribution for the "positives" (i.e., those whose blood tests indicated drug presence) detected in the E and C groups.

A multivariate statistical analysis was then conducted in order to determine whether there were any overall relationships between subjects' usage of drugs and their traffic accident and moving violation histories. Four complementary statistical techniques were used: factorial analysis of variance and covariance; stepwise regression; and pairwise correlation.

Basic sets of independent and dependent variables, listed in Table 2-1, were used throughout this analysis; detailed definitions of these variables are found in Appendix B. Here, dependent variables dealt with numbers of traffic accidents and moving traffic violations. The relationships of these dependent variables, i.e., accident and violation measures to each or 31 independent variables were studied using the above techniques.

Thus, the purpose of employing the above statistical procedures was to establish whether the values of these dependent variables, dealing with accidents and violations subjects had incurred over their driving lifetimes, were significantly related to independent variables dealing with usage or non-usage of licit and illicit drugs. In order to keep in perspective any positive or negative findings regarding the influence of such drug-usage variables, the relative statistical importance of other independent variables was simultaneously taken into account. These other possible correlates of accidents and violations, used in initial analyses as covariates, included demographic measures such as age, sex, and yearly driving mileage; personality characteristics as measured by several psychological tests, and other driving-history variables, i.e., independent measures of accidents and violations.

Relationships between drug usage, accidents and violations were first explored in broad fashion using factorial analysis of covariance (FANCOVA). Here, analysis of variance was performed for each major dependent variable both with and without adjustment for covariates, establishing the relative importance of drug-usage, psychological, demographic

Independent And Dependent Variables

TABLE 2—1

Independent Variables[1]		Dependent Variables[2]
Discrete-Valued	Continuous	
DRUG USAGE DRUG USAGE WHILE DRIVING DRUG INFLUENCES ON DRIVING LICIT DRUG USAGE ILLICIT DRUG USAGE ILLICIT DRUG INFLUENCES ON DRIVING	AGE GRADE POINT AVERAGE INCOME OF PARENTS AVERAGE TOTAL YEARLY MILEAGE MAST SCORE PELZ-SCHUMAN SCORE PRF ACHIEVEMENT SCORE PRF AFFILIATION SCORE PRF AGGRESSION SCORE PRF AUTONOMY SCORE PRF DOMINANCE SCORE PRF ENDURANCE SCORE PRF EXHIBITION SCORE PRF HARM-AVOIDANCE SCORE PRF IMPULSIVITY SCORE PRF NURTURANCE SCORE PRF ORDER SCORE PRF PLAY SCORE PRF SOCIAL RECOGNITION SCORE PRF UNDERSTANDING SCORE PRF INFREQUENCY SCORE	TOTAL DRIVING ACCIDENTS TOTAL MOVING VIOLATIONS TOTAL ACCIDENTS PER MILE TOTAL VIOLATIONS PER MILE TOTAL ACCIDENTS IN PAST 12 MONTHS TOTAL ACCIDENTS PRIOR TO 12 MONTHS TOTAL VIOLATIONS IN PAST 12 MONTHS TOTAL VIOLATIONS PRIOR TO 12 MONTHS

1. Include Demographic, Psychological, and Drug-Usage Variables

2. Driving History Variables

and driving history variables simultaneously. In order to take into account strong interrelationships anticipated among individual measures of accidents and violations, i.e., among the various dependent variables examined, all such measures not being used as a dependent variable in a particular run were used instead as covariates during that run. If, for example, a particular drug usage factor was found to be significantly related to accidents, and if subsequent adjustment for non-drug covariates made this same relationship statistically insignificant, it was argued that the non-drug covariates explained more of the total variation in the dependent variable, i.e., were statistically more important than the original drug usage factor.

FANCOVA runs were executed using BMD X64, one of a series of Biomedical Computer Programs developed at UCLA. All FANCOVA and FANOVA runs were performed on the CDC 6600-6400 system at Indiana University's Research Computing Center. BMD X64 was used because it allowed the significance of each of a set of covariates to be determined individually, together with the significance of, i.e., relative amount of between-class variation accounted for by, the entire set of such covariates considered as a whole.

FANCOVA was used largely to handle discrete-valued independent variables, e.g., "drug usage," a factor with two categories: drug user vs. non drug user. Continuous-valued variables could more appropriately be handled using techniques of correlation and regression. (Exceptions here included age, grade point average, and other continuous-valued independent variables used as covariates).

After the relative importance of drug usage, demographic and psychological variables had thus been established using FANCOVA, the next step was to determine which of these demographic, psychological and other variables correlated best with or predicted accidents and violations.

A stepwise regression program from the same BMD series, BMD 02R, was used to generate regression equations and correlation matrices for each dependent variable. This program generated a matrix of basic pairwise correlations, allowing examination of overall relationships between each independent and dependent variable, as well as between all other pairings or variables. Subsequent stepwise regressions then selected out for each dependent variable

a succession of independent variables accounting for greatest proportions of total variation in that dependent variable.

Criteria chosen for stepwise inclusion and deletion of variables in the regression equations were F = .05 and .01, respectively. By setting "liberal" criteria, it was hoped all variables having anything remotely to do with accidents and violations would be selected and retained. The low criterion value for deletion thus made these stepwise procedures closer actually to standard "forward-selection" procedures.

In theory, the regression equations generated by BMD 02R could also have been used to predict numbers of accidents or violations for any similar group of subjects. These results were used instead simply to determine which sets of variables were most strongly related to subjects' accidents and violations. For this reason, no subset of the available observations was set aside for cross-validation of these regression equations; all observations were used instead to establish basic correlational relationships.

It should be noted that restrictions in the present data precluded the use of a fully realized sequence of analysis of variance, covariance, correlation and regression analyses. Ideally, a fully-crossed factorial design would have permitted exploration of all possible levels of interaction among drug-usage and demographic variables. Yet many cells of such a design would have been empty in the present case. For example, since almost every subject was unmarried, observations needed fully to compute main effects and interactions among drug usage, sex and marital status simply were not available, although significant interaction effects of this sort would have been of direct interest. Due to the limited number of subjects falling under various combinations of factor levels, the present FANOVA and FANCOVA analyses involved only up to two-way designs. Seven basic factorial designs were used. Each of six drug-usage factors was examined in conjunction with sex. In addition, sex was run alone in a single-factor design, to isolate variation attributable to this important demographic variable. These seven designs were run both as ANOVAS and as ANCOVAS, i.e., both with and without covariates. In this way, the relative importance of factors' main and interaction effects, and of each of the demographic, psychological, and driving-history covariates could be determined.

Further, because certain drug-usage and driving history

questions on the questionnaire did not apply to a number of non-drug-using and non-driving subjects, further restrictions were made regarding the number of subjects whose data could be used in several stages of the analysis. For example, questions dealing with usage and effects of different kinds of licit and illicit drugs were assumed not to apply to subjects reporting no usage of drugs whatsoever. When these non-users were dropped, cell n's for analyses of relationships between driving accidents or violations and e.g., perceived effects of drugs on driving, were severely reduced.

In each analysis, however, maximum numbers of available observations were used. Comparability of responses among similar subgroups, together with the usual requirements of linearity and homogeniety of variances and regression, are assumed throughout.

3.0 RESULTS

3.1 Summary

The present study did not uncover any evidence that drug usage is related to motor vehicle accidents, or to moving violations, among college students. It was determined that drugs did not appear more frequently in the blood of recent motor vehicle accident victims, than in those not involved in such accidents. Instead, accident victims and non-accident controls had about the same blood drug levels, (less than 10 percent of each group of students). Only one of these (a member of the control group) could be identified as probably having used an illicit drug. Thus, on the basis of clinical evidence, no causal role can be ascribed to either licit or illicit drugs in automobile accidents.

Historical data dealing with drug-usage and driving records show that students who did not use drugs were just as likely to have had accidents or violations as those who did, all things considered (see Table 3-1). Drug usage per se, that is, was at very best indirectly related to the number of accidents and violations students had; in no case was this variable significantly related to accidents and violations.

Further, it was the general impression of the interviewer that students who were users of licit and illicit psychotropic drugs tended to avoid driving while under the influence of such drugs. Subjects claiming they drove while on marijuana often remarked that they realized that their driving was adversely affected, i.e., slower reaction time, reflexes, some vision impairment, etc., but that they consequently drove more slowly and carefully to compensate. Some reported that they felt extremely "paranoid" while driving under the influence of cannabis through fear that their erratic driving might be noticed by a law enforcement officer, and they drove much more carefully than usual. Many pointed out that this effect was markedly different from drunken driving patterns they had experienced, in which they had become recklessly self-confident and driven at excessive speed. Those claiming to have driven under the influence of psychedelic drugs reported much the same types of impairment as the marijuana smokers except in a greatly amplified form. The most commonly reported sensation among those reporting driving under the influence of psychedelics was a greatly distorted sense of time. Those claiming to have driven under the influence of amphetamines ("speed") reported increased speed and aggressiveness on the highway.

TABLE 3–1

Master Summary Of Variables Most Significantly Related To Accidents And Violation Measures

STATISTICAL ANALYSIS TECHNIQUE	DRIVING HISTORY VARIABLE			
	TRAFFIC ACCIDENTS	ACCIDENTS PER MILE	MOVING VIOLATIONS	VIOLATIONS PER MILE
X^2 Analysis of Blood Sample Data	(None)	N/A[1]	N/A	N/A
Factorial Analysis of Variance	Sex	(None)	Sex	Sex
Factorial Analysis of Covariance	Violations	Accidents Violations/ Mile	Accidents Violations/ Mile Harm-Avoidance Social Recognition	Accidents Accidents/ Mile Violations Mileage
Simple Correlation	Violations Violations/ Mile Mileage	Impulse-Expression	Accidents Violations/ Mile Mileage Alcoholism Harm-Avoidance	Accidents Violations Grades
Stepwise Regression	Violations Harm-Avoidance	Impulse-Expression Endurance	Accidents Harm-Avoidance	Accidents Mileage Grades

1. N/A=Not Applicable

Such factors as students' sex, marital status, psychological characteristics, and previous driving histories, were far more strongly related to motor vehicle accidents than drug usage. Male students, whether users or not, accounted for most of the moving violations in the sample. Interestingly, greater proportions of males than females were drug users, i.e., were using or had at some time used some form of cannabis, hallucinogen, opiate, stimulant, or barbiturate. As expected, the study showed that regardless of their drug usage patterns, males had driving mishaps more frequently than females.

Psychological characteristics, too were better predictors of the students' accidents, and particularly of their violations, than were drug usage patterns. For example, the best predictor of total accidents per driving mile over the subject's driving lifetime was his score on the Pelz-Schuman Impulse Expression Test, a measure of one's tendency to discharge feelings of frustration or anger through his driving behavior.

But the best predictors of total accidents and violations were inevitably other measures of accidents and violations. That is, subjects with more accidents could best be identified by their number of violations, and vice versa. This relationship overshadowed all others, accounting far better for numbers of such events than did any drug usage, psychological, or demographic characteristics of the students studied.

3.2 Comparative Survey

The comparative survey was conducted to investigate drug usage as a causal factor in motor vehicle accidents. Of the 107 subjects, 78 were in a group from which blood specimens were taken.* Only seven subjects out of 78 (9.0 percent) had any trace of a drug in their blood. There was no significant difference in terms of drug presence in the blood between those subjects who had just had a motor vehicle accident (E group) and those who had not (C groups). (See Table 3-2). The 95 percent confidence interval for positive blood samples was one percent to 26 percent for the experimental group and two percent to 19 percent for the control group. An overall summary of these highly negative findings is given in Table 3-3. Thus, by the rationale set down in section 2.1, further comparisons between the E group and the C groups were not conducted.

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*The results of the blood tests are presented in Appendix C.

Summary Of Results Of Comparative Survey

TABLE 3–2

Group	No. Subjects Tested	No. Positive Specimens	% Positive Specimens	Type of Drugs Present
E	24	2	8.3%	Morphine (1) Protriptyline (1)
C	54	5*	9.3%	Secobarbital (4) Morphine (1)
TOTAL	78	7	9.0%	SEE ABOVE

*All of these positive specimens were from control group C-III.

TABLE 3-3: NUMBER OF SUBJECTS IN E AND C GROUPS WITH POSITIVE DRUG READINGS IN BLOOD SAMPLES

Group	Positive Readings	Negative Readings
E	2	22
C	5	49

$\chi^2 = .088, p \leq .75$

It is of interest, however, to examine in more detail the subjects whose blood tests showed drug presence. Table 3-4 summarizes pertinent information obtained from the interviews of these subjects. Only one subject showed really strong evidence that the drug identified through the blood test was taken illicitly. This control group subject claimed to be a heavy user of illicit drugs and said that he had smoked a large quantity of opium the night before his blood test. The other subjects indicated light to moderate usage of marijuana plus some usage of antihistamines, headache remedies, sleeping medicines, etc. One control group subject sometimes used amphetamines when studying. The subjects were predominantly male (six out of seven) and their ages ranged from 18 to 26.

It was stated previously in paragraph 2.4 that no blood tests for ethanol were performed on either the E-group or the C-group. Therefore, it cannot be said with certainty that alcohol was or was not a factor in any of the motor vehicle accidents that were studied. It should be noted, however, that one subject from the E group stated to the interviewer that he had been drinking when the accident occurred.

As was mentioned in section 1.4, it was hoped at the start of the study that additional insights relative to the E-group accidents could be gained through detailed accident investigations which were conducted concurrently with the present study. However, since the detailed investigations were designed to support different objectives than those of the present study and employed different sampling techniques, there could be no assurance that a given E-group accident would also be the subject of a detailed

Profiles Of Subjects With Drug Traces In Blood

TABLE 3—4

SUBJECT	GROUP	SEX	AGE	DRUG FOUND IN BLOOD	DRUG USAGE HISTORY	
					Licit	Illicit
1	E	Male	19	Protriptyline (anti-depressant)	Periodic use of antihistamines for allergy	Moderate use of marijuana approx. 10 times per mo.
2	E	Female	18	Morphine	Frequent Darvon® for headaches	Occasional marijuana approx. one time per mo.
3	C-III	Male	26	Secobarbital	Some past use of Darvon® for headaches	Moderate use of marijuana approx. 10 times per mo.
4	C-III	Male	21	Secobarbital	Recent use of prescription antihistamine	Light use of marijuana approx. two times per mo.
5	C-III	Male	25	Secobarbital	Periodic use of prescription codeine	Past light use of marijuana
6	C-III	Male	20	Secobarbital	None	Moderate use of marijuana approx. six times per mo. Some use of amphetamines to study.
7	C-III	Male	22	Morphine	None	Heavy user of wide variety of illicit drugs. Smoked large quantity of opium night before blood test.

investigation. As it turned out, in fact, none of the E-group accidents received a detailed investigation so that these additional data were not available for the present study.

3.3 Multivariate Statistical Analysis

In the present section, results of applying the statistical techniques described in section 2.5 are presented. First, results of factorial analyses of variance and covariance are presented in Section 3.3.1, comparing the relative significance of drug usage and other variables as related to subjects' driving accident and moving violation histories. Then the relative significance of variables other than those dealing with drug usage is more fully explored in section 3.3.2, stressing correlation and regression relationships between these and the same measures of accidents and violations. The data which formed the basis for the multivariate statistical analysis are summarized in Appendix D.

3.3.1 Results of Analysis of Variance and Covariance

Due to the large number of individual analysis runs and correspondingly large numbers of ANOVA and ANCOVA summary tables that would be required to illustrate in detail all analysis of variance findings, only summary tables are presented. Dependent variables in these runs are total driving accidents, total moving violations, total driving accidents per mile and total moving violations per mile. As defined in Appendix B, total accidents and violations cover the entire driving lifetime of each subject, regardless of whether any drugs used were actually being used at the time such accidents and violations occurred. Similarly, relationships between accidents and violations per driving mile and usage of any drugs are atemporal, i.e. could be taken only to imply that those taking drugs at some time do or do not have more accidents or violations per driving mile.

The first such table (Table 3-5) summarizes all significant main effects and interactions of drug-usage factors in the presence and absence of psychological, driving-history, and demographic covariates. Thus, for each of the four dependent variables examined, results of both ANOVA and ANCOVA analyses are presented under each of the seven basic factorial designs employed.

A second set of related summary tables (3-6 through 3-9) shows the relative importance of each of the ANCOVA covariates

Summary Of Significant ANOVA And ANCOVA Findings

TABLE 3—5A

DESIGN NO.	SOURCE	DEPENDENT VARIABLE			
		TOTAL ACCIDENTS		TOTAL ACCIDENTS PER MILE	
		ANOVA	ANCOVA	ANOVA	ANCOVA
1	Sex	*			
2	Drug Usage				
	Sex	*			
	Drug Usage x Sex				
3	Drug Usage While Driving				
	Sex				
	Drug Usage While Driving x Sex				
4	Drug Influences on Driving				
	Sex				
	Drug Influences on Driving x Sex				
5	Licit Drug Usage				
	Sex				
	Licit Drug Usage x Sex				
6	Illicit Drug Usage				
	Sex	*			
	Illicit Drug Usage x Sex				
7	Illicit Drug Influences on Driving				
	Sex				
	Illicit Drug Influences on Driving x Sex				

*$p \leq .05$, **$p \leq .01$, ***$p \leq .001$

TABLE 3—5B

Summary Of Significant ANOVA And ANCOVA Findings (Continued)

DESIGN NO.	SOURCE	DEPENDENT VARIABLE			
		TOTAL VIOLATIONS		TOTAL VIOLATIONS PER MILE	
		ANOVA	ANCOVA	ANOVA	ANCOVA
1	Sex	***		*	
2	Drug Usage				
	Sex	*			
	Drug Usage x Sex				
3	Drug Usage While Driving				
	Sex	**			
	Drug Usage While Driving x Sex				
4	Drug Influences on Driving				
	Sex				
	Drug Influences on Driving x Sex				
5	Licit Drug Usage				
	Sex	**			
	Licit Drug Usage x Sex				
6	Illicit Drug Usage				
	Sex	**			
	Illicit Drug Usage x Sex				
	Illicit Drug Influences on Driving				
	Sex				
	Illicit Drug Influences on Driving x Sex				

*p≤.05, **p≤.01, ***p≤.001

TABLE 3–6A

Summary Of Statistically Significant ANCOVA Covariates, For Total Accidents

COVARIATE	FACTOR		
	SEX	DRUG USAGE	DRUG USAGE WHILE DRIVING
All Covariates	**	**	**
Age			
Grade Point Average			
Av. Total Yearly Mileage			
Parents' Income			
MAST			
Pelz-Schuman			
PRF Achievement			
PRF Affiliation			
PRF Aggression			
PRF Autonomy			
PRF Dominance			
PRF Endurance			
PRF Exhibition			
PRF Harm-avoidance			
PRF Impulsivity			
PRF Nurturance			
PRF Order			*
PRF Play			
PRF Social Recognition	*	*	*
PRF Understanding			
PRF Infrequency			
Total Accidents	-	-	-
Total Violations	***	***	***
Total Accidents Per Mile			
Total Violations Per Mile			

*$p \leq .05$ **$p \leq .01$ ***$p \leq .001$

TABLE 3—6B

Summary Of Statisically Statistically ANCOVA Covariates, For Total Accidents (Continued)

COVARIATE	FACTOR		
	DRUG INFLUENCES ON DRIVING	LICIT DRUG USAGE	ILLICIT DRUG USAGE
All Covariates	***	***	**
Age			
Grade Point Average			
Av. Total Yearly Mileage			
Parents' Income			
MAST			
Pelz-Schuman			
PRF Achievement			
PRF Affiliation			
PRF Aggression			
PRF Autonomy			
PRF Dominance		*	
PRF Endurance			
PRF Exhibition			
PRF Harm-avoidance		*	
PRF Impulsivity			
PRF Nurturance			
PRF Order		**	
PRF Play		*	
PRF Social Recognition		**	*
PRF Understanding			
PRF Infrequency			
Total Accidents	-	-	-
Total Violations	*	***	***
Total Accidents Per Mile	***		
Total Violations Per Mile	**		

*p≤.05, **p≤.01, ***p≤.001

TABLE 3—6C

Summary Of Statistically Significant ANCOVA Covariates, For Total Accidents (Continued)

COVARIATE	FACTOR
	ILLICIT DRUG INFLUENCES ON DRIVING
All Covariates	***
Age	
Grade Point Average	
Av. Total Yearly Mileage	
Parents' Income	
MAST	
Pelz-Schuman	
PRF Achievement	
PRF Affiliation	
PRF Aggression	
PRF Autonomy	
PRF Dominance	
PRF Endurance	
PRF Exhibition	
PRF Harm-avoidance	
PRF Impulsivity	
PRF Nurturance	
PRF Order	
PRF Play	
PRF Social Recognition	
PRF Understanding	
PRF Infrequency	
Total Accidents	-
Total Violations	
Total Accidents Per Mile	**
Total Violations Per Mile	*

*$p \leq .05$, **$p \leq .01$, ***$p \leq .001$

TABLE 3–7A

Summary Of Statistically Significant ANCOVA Covariates, For Total Accidents Per Mile

COVARIATE	FACTOR		
	SEX	DRUG USAGE	DRUG USAGE WHILE DRIVING
All Covariates			
Age			
Grade Point Average			
Av. Total Yearly Mileage			
Parents' Income			
MAST			
Pelz-Schuman	*		
PRF Achievement			
PRF Affiliation	*	*	*
PRF Aggression			
PRF Autonomy			
PRF Dominance			
PRF Endurance	*	*	*
PRF Exhibition			
PRF Harm-avoidance			
PRF Impulsivity			
PRF Nurturance			
PRF Order			
PRF Play			
PRF Social Recognition			
PRF Understanding			
PRF Infrequency			
Total Accidents			
Total Violations			
Total Accidents Per Mile	-	–	–
Total Violations Per Mile			

*$p \leq .05$, **$p \leq .01$, ***$p \leq .001$

TABLE 3—7B

Summary Of Statistically Significant ANCOVA Covariates, For Total Accidents Per Mile (Continued)

COVARIATE	FACTOR		
	DRUG INFLUENCES ON DRIVING	LICIT DRUG USAGE	ILLICIT DRUG USAGE
All Covariates	***		
Age			
Grade Point Average			
Av. Total Yearly Mileage			
Parents' Income			
MAST			
Pelz-Schuman			*
PRF Achievement			
PRF Affiliation		*	*
PRF Aggression			
PRF Autonomy			
PRF Dominance			
PRF Endurance		*	*
PRF Exhibition			
PRF Harm-avoidance			
PRF Impulsivity			
PRF Nurturance			
PRF Order			
PRF Play			
PRF Social Recognition			
PRF Understanding	*		
PRF Infrequency			
Total Accidents	***		
Total Violations			
Total Accidents Per Mile	—	-	-
Total Violations Per Mile	***		

*p≤.05, **p≤.01, ***p≤.001

TABLE 3—7C

Summary Of Statistically Significant ANCOVA Covariates, For Total Accidents Per Mile (Continued)

COVARIATE	FACTOR
	ILLICIT DRUG INFLUENCES ON DRIVING
All Covariates	***
Age	
Grade Point Average	
Av. Total Yearly Mileage	
Parents' Income	
MAST	
Pelz-Schuman	
PRF Achievement	
PRF Affiliation	
PRF Aggression	
PRF Autonomy	
PRF Dominance	
PRF Endurance	
PRF Exhibition	
PRF Harm-avoidance	
PRF Impulsivity	
PRF Nurturance	
PRF Order	
PRF Play	
PRF Social Recognition	
PRF Understanding	
PRF Infrequency	
Total Accidents	**
Total Violations	
Total Accidents Per Mile	-
Total Viclations Per Mile	***

*$p \leq .05$, **$p \leq .01$, ***$p \leq .001$

TABLE 3—8A

Summary Of Statistically Significant ANCOVA Covariates, For Total Violations

COVARIATE	FACTOR		
	SEX	DRUG USAGE	DRUG USAGE WHILE DRIVING
All Covariates	***	***	***
Age			
Grade Point Average			
Av. Total Yearly Mileage		*	
Parents' Income			
MAST			
Pelz-Schuman			
PRF Achievement			
PRF Affiliation			
PRF Aggression			
PRF Autonomy			
PRF Dominance		*	
PRF Endurance	*	*	*
PRF Exhibition			
PRF Harm-avoidance	**	**	*
PRF Impulsivity			
PRF Nurturance			
PRF Order			
PRF Play			
PRF Social Recognition	*	*	*
PRF Understanding			
PRF Infrequency	*		*
Total Accidents	***	***	***
Total Violations	-	-	-
Total Accidents Per Mile	***		
Total Violations Per Mile		***	***

*$p \leq .05$, **$p \leq .01$, ***$p \leq .001$

TABLE 3—8B

Summary Of Statistically Significant ANCOVA Covariates, For Total Violations (Continued)

COVARIATE	FACTOR		
	DRUG INFLUENCES ON DRIVING	LICIT DRUG USAGE	ILLICIT DRUG USAGE
All Covariates	***	***	***
Age			
Grade Point Average			
Av. Total Yearly Mileage	*		
Parents' Income			
MAST			
Pelz-Schuman			
PRF Achievement			
PRF Affiliation			
PRF Aggression			
PRF Autonomy			
PRF Dominance		*	
PRF Endurance		*	*
PRF Exhibition			
PRF Harm-avoidance		**	**
PRF Impulsivity			
PRF Nurturance			
PRF Order		*	
PRF Play			
PRF Social Recognition		**	*
PRF Understanding			
PRF Infrequency		*	*
Total Accidents	*	***	***
Total Violations	-	-	-
Total Accidents Per Mile			
Total Violations Per Mile	***	***	***

*$p \leq .05$, **$p \leq .01$, ***$p \leq .001$

TABLE 3—8C

Summary Of Statistically Significant ANCOVA Covariates, For Total Violations (Continued)

COVARIATE	FACTOR
	ILLICIT DRUG INFLUENCES ON DRIVING
All Covariates	***
Age	
Grade Point Average	
Av. Total Yearly Mileage	*
Parents' Income	
MAST	
Pelz-Schuman	
PRF Achievement	
PRF Affiliation	
PRF Aggression	
PRF Autonomy	
PRF Dominance	
PRF Endurance	
PRF Exhibition	
PRF Harm-avoidance	
PRF Impulsivity	
PRF Nurturance	
PRF Order	
PRF Play	
PRF Social Recognition	
PRF Understanding	
PRF Infrequency	
Total Accidents	
Total Violations	-
Total Accidents Per Mile	
Total Violations Per Mile	**

*$p \leq .05$, **$p \leq .01$, ***$p \leq .001$

TABLE 3—9A

Summary Of Statistically Significant ANCOVA Covariates, For Total Violations Per Mile

COVARIATE	FACTOR		
	SEX	DRUG USAGE	DRUG USAGE WHILE DRIVING
All Covariates	***	***	***
Age			
Grade Point Average		*	
Av. Total Yearly Mileage	***	***	***
Parents' Income			
MAST			
Pelz-Schuman			
PRF Achievement			
PRF Affiliation			
PRF Aggression			
PRF Autonomy			
PRF Dominance			
PRF Endurance			
PRF Exhibition			
PRF Harm-avoidance			
PRF Impulsivity			
PRF Nurturance	*	*	*
PRF Order			
PRF Play			
PRF Social Recognition			
PRF Understanding			
PRF Infrequency			
Total Accidents			
Total Violations	***	***	***
Total Accidents Per Mile			
Total Violations Per Mile	-	-	-

*p≤.05, **p≤.01, ***p≤.001

Summary Of Statistically Significant ANCOVA Covariates, For Total Violations Per Mile (Continued)

TABLE 3—9B

COVARIATE	FACTOR		
	DRUG INFLUENCES ON DRIVING	LICIT DRUG USAGE	ILLICIT DRUG USAGE
All Covariates	***	***	***
Age			
Grade Point Average			*
Av. Total Yearly Mileage		**	***
Parents' Income			
MAST			
Pelz-Schuman			
PRF Achievement			
PRF Affiliation			
PRF Aggression			
PRF Autonomy			
PRF Dominance			
PRF Endurance			
PRF Exhibition			
PRF Harm-avoidance			
PRF Impulsivity			
PRF Nurturance		*	*
PRF Order			
PRF Play			
PRF Social Recognition			
PRF Understanding			
PRF Infrequency			
Total Accidents	**		
Total Violations	***	***	***
Total Accidents Per Mile	***		
Total Violations Per Mile	-	-	-

*p≤.05, **p≤.01, ***p≤.001

TABLE 3—9C

Summary Of Statistically Significant ANCOVA Covariates, For Total Violations Per Mile (Continued)

COVARIATE	FACTOR
	ILLICIT DRUG INFLUENCES ON DRIVING
All Covariates	***
Age	
Grade Point Average	
Av. Total Yearly Mileage	
Parents' Income	
MAST	
Pelz-Schuman	
PRF Achievement	
PRF Affiliation	
PRF Aggression	
PRF Autonomy	
PRF Dominance	
PRF Endurance	
PRF Exhibition	
PRF Harm-avoidance	
PRF Impulsivity	
PRF Nurturance	
PRF Order	
PRF Play	
PRF Social Recognition	
PRF Understanding	
PRF Infrequency	
Total Accidents	*
Total Violations	**
Total Accidents Per Mile	***
Total Violations Per Mile	-

*$p \leq .05$, **$p \leq .01$, ***$p \leq .001$

examined. The statistical significance of each of these demographic, psychological, and driving-history covariates is thus indicated for each of the dependent variables, under each of the seven basic designs. These tables indicate which covariates were most strongly related to each dependent variable, in the presence of sex and each of the drug-usage factors.

It may be seen in Table 3-5 that sex was the only factor showing significant main effects under any of the four dependent variables. These significant effects of sex per se, as well as of sex in the presence of each of the drug-usage factors, occurred only before covariates were introduced, i.e. appear only under the ANOVA columns of the table. When covariates were introduced, these main effects were invariably reduced to levels of statistical insignificance. It is further clear in Table 3-5 that sex under ANOVA was most strongly related to total violations, somewhat less to total accidents, only on the grossest level to total violations per mile, and not at all to total accidents per mile.

These significant main effects of sex upon total driving accidents, violations, and violations per mile are plotted in Figure 3-1 through 3-3, respectively. In each case, males had significantly higher average numbers of driving mishaps. It must nevertheless be remembered that the relationships illustrated in these three figures apply only prior to adjustment for the effects of covariates. When the relative contributions of these covariates are taken into account, differences between male and female subjects' accident and violation histories disappear. In their place, demographic, psychological and driving-history covariates come to the fore.

Turning to Tables 3-6 through 3-9, it is clear that the amount of variation accounted for by driving-history and occasional psychological covariates was considerably greater than accounted for by sex or by any of the drug-usage factors. For most drug-usage factors, the collection of covariates taken as a whole accounted for highly significant amounts of variations in subjects' accidents and violations, as indicated in each table under "All Covariates."

In particular, other measures of accidents and violations were the most significantly related to each of the dependent variables. Total accidents (Table 3-6) was most significantly and consistently related to total violations subjects had incurred. Total violations (Table 3-8), in contrast, was strongly related to both total accidents and to total violations per mile.

FIGURE 3—1: Main Effect Of Sex On Total Driving Accidents ($p \leq .05$)

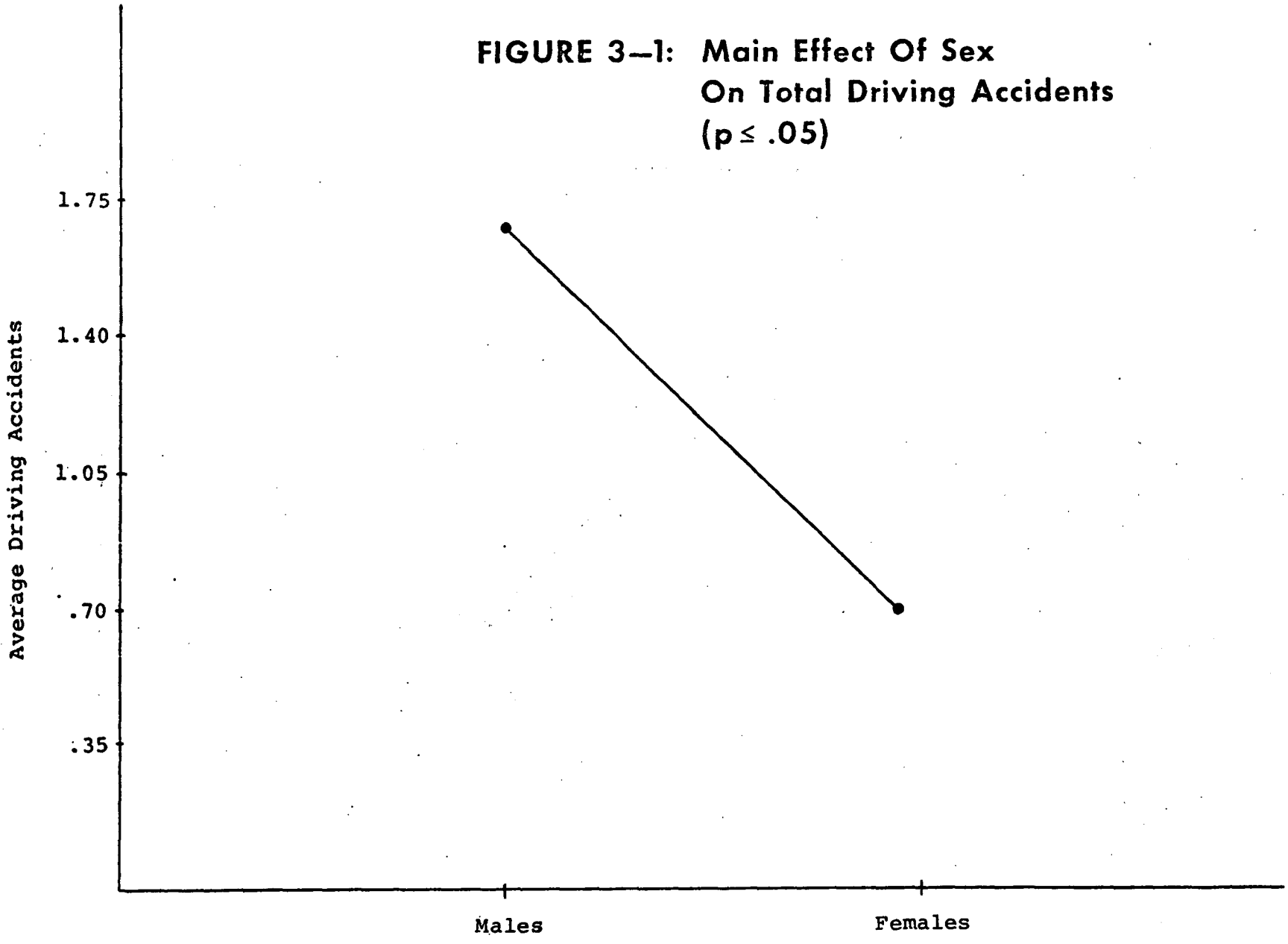


FIGURE 3—2: Main Effect Of Sex On Total Moving Violations ($p \leq .001$)

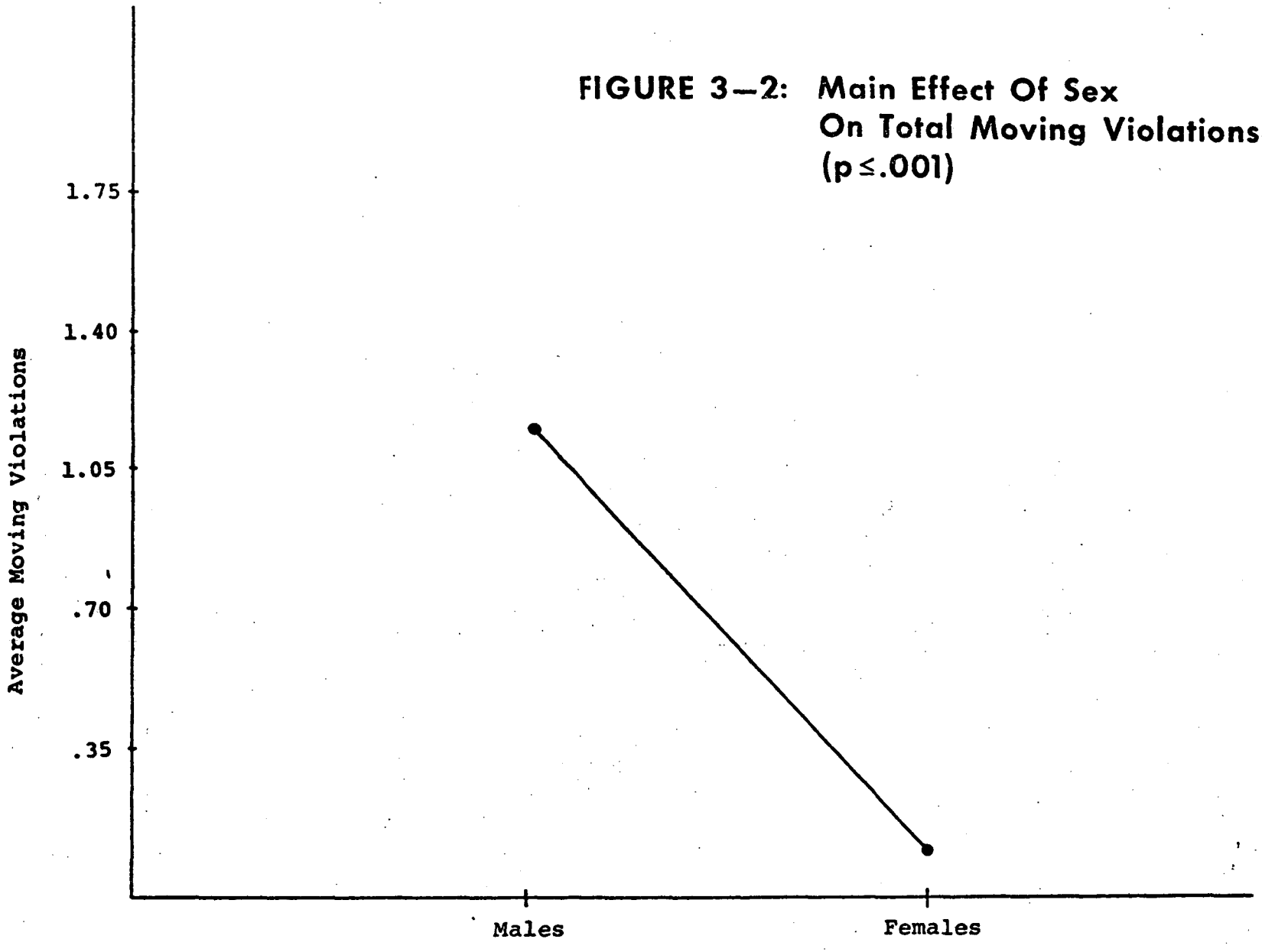
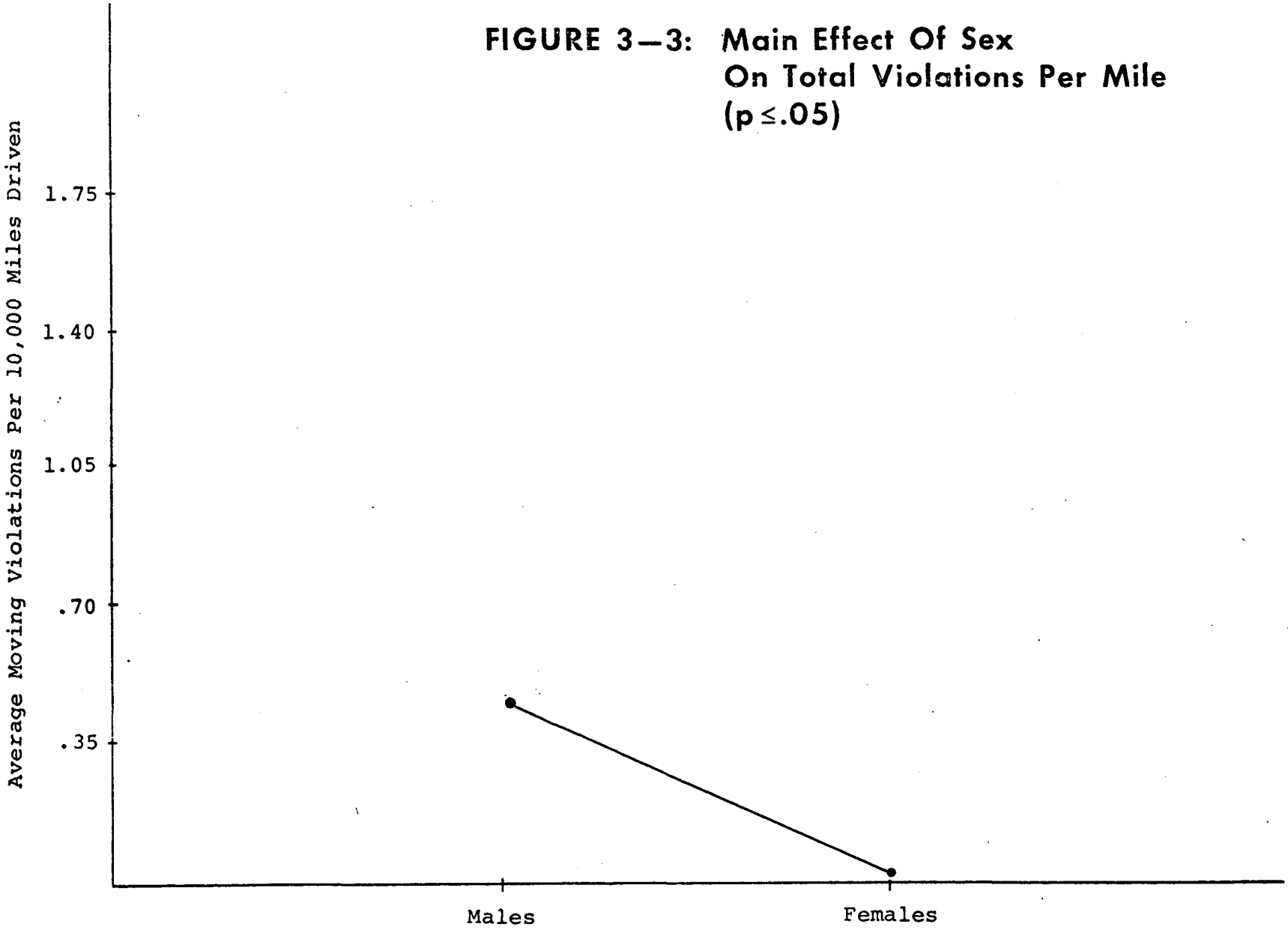


FIGURE 3—3: Main Effect Of Sex On Total Violations Per Mile ($p \leq .05$)



When adjusted for the approximate number of miles subjects had driven (Table 3-7), accidents were less strongly related to other measures of accidents and violations. In contrast, violations per mile (Table 3-9) was strongly and consistently related both to total violations and to average total yearly mileage, although the three measures are theoretically independent.

Of the four dependent variables, total violations (Table 3-8) was most strongly related to psychological covariates, followed by total accidents (Table 3-6). Certain psychological scales were related to a number of different variables. These were Pelz-Schuman scores and scores on the PRF Affiliation, Endurance, Harm-avoidance, Order, and Social Recognition scales.

In summary, drug-usage variables failed to show significant statistical relationships to accidents and violations, even after these measures were adjusted for total miles subjects had driven. Neither drug usage per se, drug usage while driving, drug influences on driving, use of illicit drugs, use of licit drugs, nor illicit drug influences on driving were significantly related to any measure of accidents or violations. These relationships held both before and after adjustment for psychological, demographic and other driving-history covariates.

In each case, these covariates collectively accounted for significant amounts of variation in total accidents and violations among subjects. Specifically, the three covariates dealing with other measures of accidents and violations were strongly related to each of the dependent variables, indicating these measures accounted more for accident history differences among subjects than did the use or perceived impairment effects of drugs of any kind.

This greater importance of non-drug variables in accounting for accidents and violations is explored more fully in the next section, where the significance of each of the above covariates, together with other more detailed measures of accidents and violations, is closely analyzed.

3.3.2 Results of Correlation and Regression Analyses

In the above analyses of covariance, the importance of non-drug variables was considered only relative to, i.e., in the context of relative contributions of drug usage variables to accidents and violations. Removed from this context, the

relationships of non-drug variables to driving mishaps may thus be more sharply defined. As will be indicated, these relationships follow the pattern suggested above, viz. measures of accidents and violations generally correlated best with other measures of accidents and violations.

A complete matrix of pairwise product-moment correlation coefficients is presented in Table 3-10, where positive or negative correlations significant at the .05 level or better (i.e., $r \geq .205$) have been circled. Here it is seen that e.g., total driving accidents correlated significantly only with total accidents prior to the past 12 months (.88), total accidents in the past 12 months (.66), total moving violations (.59), total violations prior to the past 12 months (.58), total violations per mile (.34) and total yearly mileage (.21). No demographic variable (age, grade point average, income of parents, etc.) correlated significantly with total accidents. Nor did any of the psychological test scores (MAST, Pelz-Schuman, or PRF) show significant correlations with total accidents.

When subjects' accidents were weighted for miles driven, however, no such correlations with other accident or violation measures were found. Instead, the only variable correlating significantly with total accidents per mile was a psychological one, score on the Pelz-Schuman Impulse Expression Scale, a measure described above in Section 2.3.2.

Turning from accidents to violations, it is clear that violations per se were more strongly related to psychological variables than were accidents. For while total violations correlated most strongly with other measures of accidents, violations, and mileage, they also correlated significantly with grade point average (-.26) and eight different psychological measures: MAST (.31), Pelz-Schuman (.24), and six PRF scales, five of which showed significant negative correlations with total violations. Thus subjects with more total violations had higher MAST, Pelz-Schuman, and PRF Infrequency scores, and lower grade point averages, PRF Affiliation, Endurance, Harm-avoidance, Nurturance, and Achievement scores, than did other subjects.

Total violations per mile, on the other hand, were completely unrelated to such psychological measures, correlating instead, as did total accidents, mostly with other measures of violations and accidents. As for total violations per se, however, total violations per mile increased significantly as grade point averages decreased (-.25).

TABLE 3—10A

Pairwise Correlations Between Regression Variables

NO.	VARIABLE	2	3	4	5	6
1	Total Driving Accidents	.59	-.02	.34	.13	-.09
2	Total Moving Violations	—	-.07	.52	.12	-.26
3	Total Accidents Per Mile		—	-.03	-.13	.10
4	Total Violations Per Mile			—	-.01	-.25
5	Age				—	.18
6	Grade Point Average					—
7	Income of Parents					
8	MAST Score					
9	Pelz-Schuman Score					
10	PRF Affiliation Score					
11	PRF Aggression Score					
12	PRF Autonomy Score					
13	PRF Dominance Score					
14	PRF Endurance Score					
15	PRF Exhibition Score					
16	PRF Harm-Avoidance Score					
17	PRF Impulsivity Score					
18	PRF Nurturance Score					
19	PRF Order Score					
20	PRF Play Score					
21	PRF Social Recognition Score					
22	PRF Understanding Score					
23	PRF Infrequency Score					
24	Average Total Yearly Mileage					
25	Total Accidents in Past 12 Months					
26	Total Accidents Prior to Past 12 Months					
27	Total Violations in Past 12 Months					
28	Total Violations Prior to Past 12 Months					
29	PRF Achievement Score					

Continued. . .

TABLE 3—10B

Pairwise Correlations Between Regression Variables (Continued)

NO.	VARIABLE	7	8	9	10	11
1	Total Driving Accidents	.08	.19	.14	-.08	.10
2	Total Moving Violations	.04	.31	.24	-.21	.17
3	Total Accidents Per Mile	.20	-.05	-.23	-.20	-.11
4	Total Violations Per Mile	-.09	.07	.17	-.03	.05
5	Age	-.06	-.08	-.19	-.02	-.06
6	Grade Point Average	-.12	-.28	-.39	-.13	-.09
7	Income of Parents	-	.07	.01	.03	-.07
8	MAST Score		-	.51	-.23	.35
9	Pelz-Schuman Score			-	-.01	.40
10	PRF Affiliation Score				-	.31
11	PRF Aggression Score					
12	PRF Autonomy Score					
13	PRF Dominance Score					
14	PRF Endurance Score					
15	PRF Exhibition Score					
16	PRF Harm-Avoidance Score					
17	PRF Impulsivity Score					
18	PRF Nurturance Score					
19	PRF Order Score					
20	PRF Play Score					
21	PRF Social Recognition Score					
22	PRF Understanding Score					
23	PRF Infrequency Score					
24	Average Total Yearly Mileage					
25	Total Violations in Past 12 Months					
26	Total Accidents Prior to Past 12 Months					
27	Total Violations Past 12 Months					
28	Total Violations Prior to Past 12 Months					
29	PRF Achievement Score					

Continued. . .

TABLE 3—10C

Pairwise Correlations Between Regression Variables (Continued)

NO.	VARIABLE	12	13	14	15	16
1	Total Driving Accidents	.10	.005	-.12	.02	-.06
2	Total Moving Violations	.18	.000	-.26	-.01	-.29
3	Total Accidents Per Mile	-.02	-.14	-.20	-.10	.08
4	Total Violations Per Mile	.01	.003	-.05	-.04	-.08
5	Age	.03	.21	.03	.01	.01
6	Grade Point Average	-.04	.01	.08	-.11	.29
7	Income of Parents	.10	.23	-.004	.21	-.10
8	MAST Score	.14	-.005	-.09	.10	-.37
9	Pelz-Schuman Score	.15	.12	-.09	.25	-.37
10	PRF Affiliation Score	-.47	.22	.13	.28	.07
11	PRF Aggression Score	.13	-.06	-.06	.36	-.26
12	PRF Autonomy Score	-	-	.13	-.10	-.29
13	PRF Dominance Score			.43	.67	-.20
14	PRF Endurance Score			-	.24	-.12
15	PRF Exhibition Score				-	-.20
16	PRF Harm-Avoidance Score					-
17	PRF Impulsivity Score					
18	PRF Nurturance Score					
19	PRF Order Score					
20	PRF Play Score					
21	PRF Social Recognition Score					
22	PRF Understanding Score					
23	PRF Infrequency Score					
24	Average Total Yearly Mileage					
25	Total Accidents in Past 12 Months					
26	Total Accidents Prior to Past 12 Months					
27	Total Violations in Past 12 Months					
28	Total Violations Prior to Past 12 Months					
29	PRF Achievement Score					

Continued...

TABLE 3–10D

Pairwise Correlations Between Regression Variables (Continued)

NO.	VARIABLE	17	18	19	20	21
1	Total Driving Accidents	.08	-.15	-.09	-.07	-.03
2	Total Moving Violations	.09	(-.27)	-.03	.06	-.18
3	Total Accidents Per Mile	.13	.01	-.13	-.06	-.15
4	Total Violations Per Mile	.06	.15	-.06	-.02	-.15
5	Age	-.12	-.16	-.04	-.35	-.09
6	Grade Point Average	-.17	-.10	-.01	-.27	-.06
7	Income of Parents	-.06	.03	.06	-.001	.04
8	MAST Score	.18	(-.26)	-.08	(.34)	.02
9	Pelz-Schuman Score	(.23)	-.01	-.05	(.37)	.09
10	PRF Affiliation Score	-.06	(.49)	.10	(.24)	(.31)
11	PRF Aggression Score	(.21)	(-.30)	.03	(.32)	(.21)
12	PRF Autonomy Score	(.25)	-.13	(-.29)	-.01	(-.47)
13	PRF Dominance Score	-.09	.11	-.003	.05	(.46)
14	PRF Endurance Score	-.10	(.28)	.10	-.03	.03
15	PRF Exhibition Score	.14	.12	.05	(.32)	(.44)
16	PRF Harm-Avoidance Score	(-.23)	.12	(.21)	(-.31)	.02
17	PRF Impulsivity Score		.18	(-.57)	(.36)	-.19
18	PRF Nurturance Score		-	-.10	.18	-.01
19	PRF Order Score			-	-.02	(.40)
20	PRF Play Score				-	.20
21	PRF Social Recognition Score					-
22	PRF Understanding Score					
23	PRF Infrequency Score					
24	Average Total Yearly Mileage					
25	Total Accidents in Past 12 Months					
26	Total Accidents Prior to Past 12 Months					
27	Total Violations in Past 12 Months					
28	Total Violations Prior to Past 12 Months					
29	PRF Achievement Score					

Continued...

TABLE 3–10E

Pairwise Correlations Between Regression Variables (Continued)

NO.	VARIABLE	22	23	24	25	26
1	Total Driving Accidents	-.07	.12	.21	.66	.88
2	Total Moving Violations	-.18	.28	.31	.36	.53
3	Total Accidents Per Mile	.01	.08	-.09	.05	-.06
4	Total Violations Per Mile	.001	.06	-.15	.20	.32
5	Age	.19	.05	.15	.02	.15
6	Grade Point Average	.28	-.02	.15	-.15	-.02
7	Income of Parents	-.04	.03	.24	.14	.01
8	MAST Score	-.17	.04	.22	.09	.19
9	Pelz-Schuman Score	-.08	-.12	.18	.17	.07
10	PRF Affiliation Score	.12	-.35	-.07	-.11	-.04
11	PRF Aggression Score	-.27	.20	.05	-.01	.13
12	PRF Autonomy Score	.15	.23	.12	.06	.09
13	PRF Dominance Score	.16	-.07	.17	-.08	.06
14	PRF Endurance Score	.30	-.13	-.06	-.22	-.02
15	PRF Exhibition Score	.02	-.16	.18	-.01	.03
16	PRF Harm-Avoidance Score	.02	-.01	-.10	.11	-.14
17	PRF Impulsivity Score	-.01	.08	-.07	.01	.10
18	PRF Nurturance Score	.13	-.28	-.19	-.15	-.10
19	PRF Order Score	-.21	-.05	.22	.02	-.14
20	PRF Play Score	-.34	-.17	.10	-.04	-.06
21	PRF Social Recognition Score	.18	-.12	.06	.08	-.10
22	PRF Understanding Score	-	-.13	-.05	-.10	-.03
23	PRF Infrequency Score		-	.04	.19	.04
24	Average Total Yearly Mileage			-	.21	.14
25	Total Accidents in Past 12 Months				-	.23
26	Total Accidents Prior to Past 12 Months					-
27	Total Violations in Past 12 Months					
28	Total Violations Prior to Past 12 Months					
29	PRF Achievement Score					

Continued...

TABLE 3—10F

Pairwise Correlations Between Regression Variables (Continued)

NO.	VARIABLE	27	28	29
1	Total Driving Accidents	.30	.58	-.07
2	Total Moving Violations	.69	.88	-.27
3	Total Accidents Per Mile	-.06	-.06	-.05
4	Total Violations Per Mile	.32	.48	-.06
5	Age	-.04	.19	.12
6	Grade Point Average	-.30	-.14	.27
7	Income of Parents	.17	-.05	.16
8	MAST Score	-.34	.19	-.18
9	Pelz-Schuman Score	.29	.13	-.21
10	PRF Affiliation Score	-.24	-.13	.11
11	PRF Aggression Score	.14	.14	-.03
12	PRF Autonomy Score	.19	.11	.06
13	PRF Dominance Score	-.02	.01	.39
14	PRF Endurance Score	-.14	-.25	.64
15	PRF Exhibition Score	-.11	.05	.24
16	PRF Harm-Avoidance Score	-.30	-.18	-.12
17	PRF Impulsivity Score	.07	.08	-.17
18	PRF Nurturance Score	-.18	-.24	.25
19	PRF Order Score	-.05	-.01	.15
20	PRF Play Score	.12	-.001	-.20
21	PRF Social Recognition Score	-.19	-.12	.13
22	PRF Understanding Score	-.11	-.17	.37
23	PRF Infrequency Score	.35	.15	-.20
24	Average Total Yearly Mileage	.16	.30	.001
25	Total Accidents in Past 12 Months			-.16
26	Total Accidents Prior to Past 12 Months			.01
27	Total Violations in Past 12 Months	-	.25	-.30
28	Total Violations Prior to Past 12 Months		-	-.16
29	PRF Achievement Score			

It is of interest to note in passing that psychological test scores were in certain cases significantly correlated with other test scores. In particular, MAST and Pelz-Schuman scores were significantly correlated across subjects (.51), as were Pelz-Schuman scores and PRF aggression scores (.40). Lending further evidence of validity to these psychological findings is the significantly high negative correlation observed between PRF Impulsivity and PRF order scores (-.57).

Turning to the results of applying stepwise analysis to the relationships between major dependent variables and all other variables, we may see in Tables 3-11 through 3-14 that, as expected, the variable found above to have the strongest individual correlation with the dependent variable at hand was the first selected by the stepwise procedure, and was always included first in the "best" regression equation for that dependent variable. In these tables, the indicated values and significance levels of F for regression refer to the significance of the amount of non-residual variation accounted for by the regression equation when the indicated variable was selected. R^2 instead indicates the proportion of total variation accounted for by this equation.

Of greater interest here were the variables selected second, which were not necessarily those showing the second-highest overall correlations in the above matrix. In predicting total driving accidents, the second variable selected was total violations prior to the past 12 months (Table 3-11). But for total moving violations and total accidents per mile, the second variables selected were in each case psychological test scores: the PRF Harm-avoidance scores and PRF Endurance scores, respectively. Finally, for total violations per mile, the second variable selected was average total yearly mileage (Table 3-14).

Thus stepwise regression analysis provides a different perspective on the relationships between accident and violation measures, demographic and psychological characteristics. Once a variable is selected to be included in the regression equation, the effects of that variable are statistically "held constant," and the relative importance of each individual variable in the remaining collection reappraised independently of any interrelationship it may have had with the variable removed. Following this procedure, it appears that the importance of psychological test scores is relatively greater than that of remaining measures of accidents and violations, a finding only partially implied in the above analysis of simple correlations. For in each of Tables 3-11 through 3-14, the relative contributions of

Results Of Stepwise Regression For Total Driving Accidents

TABLE 3—11

Order of Selection	Variable	Multiple R	R^2	Increase in R^2	F for Regression
1	Total Moving Violations	.5856	.3429	.3429	46.97***
2	Total Violations Prior to Past 12 Months	.6036	.3543	.0214	25.50***
3	PRF Harm-Avoidance Score	.6112	.3736	.0093	17.50***
4	PRF Order Score	.6196	.3840	.0104	13.56***
5	PRF Social Recognition Score	.6305	.3976	.0136	11.35***
6	PRF Achievement Score	.6415	.4115	.0140	9.99***
7	PRF Dominance Score	.6488	.4210	.0094	8.72***
8	Income of Parents	.6548	.4288	.0078	7.79***
9	PRF Endurance Score	.6609	.4368	.0081	7.07***
10	Pelz-Schuman Score	.6656	.4430	.0062	6.44***
11	PRF Play Score	.6714	.4508	.0078	5.97***
12	Age	.6739	.4541	.0033	5.48***
13	PRF Ingrequency Score	.6756	.4564	.0023	5.04***
14	PRF Aggression Score	.6779	.4595	.0031	4.68***
15	Average Total Yearly Mileage	.6797	.4620	.0025	4.35***
16	PRF Affiliation Score	.6810	.4638	.0018	4.05***
17	PRF Autonomy Score	.6827	.4661	.0023	3.80***
18	Grade Point Average	.6842	.4681	.0020	3.57***
19	PRF Understanding Score	.6856	.4701	.0020	3.36***
20	Total Violations Per Mile	.6872	.4723	.0022	3.18***
21	MAST Score	.6880	.4733	.0010	3.00***
22	PRF Nurturance Score	.6883	.4738	.0005	2.82***

*$p \leq .05$
**$p \leq .01$
***$p \leq .001$

TABLE 3—12

Results Of Stepwise Regression For Total Accidents Per Mile

Order of Selection	Variable	Multiple R	R^2	Increase In R^2	F for Regression
1	Pelz-Schuman Score	.2285	.0522	.0522	4.96*
2	PRF Endurance Score	.3201	.1025	.0502	5.08**
3	Income of Parents	.3802	.1445	.0421	4.96**
4	PRF Impulsivity Score	.4243	.1800	.0355	4.76**
5	PRF Affiliation Score	.4567	.2086	.0286	4.53**
6	Age	.4827	.2330	.0244	4.30**
7	PRF Understanding Score	.4961	.2462	.0131	3.92**
8	PRF Autonomy Score	.5126	.2628	.0166	3.70**
9	PRF Nurturance Score	.5228	.2734	.0106	3.43**
10	Total Violations in Past 12 Mo.	.5287	.2795	.0062	3.14**
11	PRF Social Recognition Score	.5348	.2860	.0065	2.91**
12	PRF Infrequency Score	.5399	.2915	.0055	2.71**
13	PRF Play Score	.5455	.2976	.0061	2.54**
14	PRF Dominance Score	.5491	.3015	.0039	2.37*
15	PRF Aggression Score	.5542	.3071	.0056	2.24*
16	Average Total Yearly Mileage	.5582	.3116	.0045	2.12*
17	MAST Score	.5611	.3148	.0033	2.00*
18	PRF Order Score	.5634	.3175	.0026	1.87*
19	PRF Harm-Avoidance Score	.5655	.3198	.0023	1.78
20	PRF Exhibition Score	.5658	.3202	.0004	1.67
21	PRF Achievement Score	.5662	.3206	.0004	1.57
22	Total Violations Prior to Past 12 Months	.5665	.3209	.0004	1.48
23	Total Violations Per Mile	.5668	.3212	.0003	1.40

*$p \leq .05$
**$p \leq .01$
***$p \leq .001$

TABLE 3—13

Results Of Stepwise Regression For Total Moving Violations

Order of Selection	Variable	Multiple R	R^2	Increase in R^2	F For Regression
1	Total Driving Accidents	.5856	.3429	.3429	46.97***
2	PRF Harm-Avoidance Score	.6394	.4088	.0659	30.77***
3	PRF Achievement Score	.6907	.4770	.0682	26.76***
4	PRF Infrequency Score	.7102	.5044	.0274	22.14***
5	Average Total Yearly Mileage	.7286	.5309	.0264	19.46***
6	PRF Social Recognition Score	.7382	.5449	.0141	16.96***
7	PRF Order Score	.7508	.5637	.0188	15.50***
8	PRF Dominance Score	.7620	.5806	.0169	14.36***
9	PRF Endurance Score	.7759	.6021	.0215	13.79***
10	Income of Parents	.7800	.6085	.0064	12.59***
11	Grade Point Average	.7846	.6155	.0071	11.64***
12	MAST Score	.7875	.6202	.0046	10.75***
13	Pelz-Schuman Score	.7904	.6247	.0045	9.99***
14	Total Accidents Per Mile	.7936	.6298	.0052	9.36***
15	PRF Play Score	.7946	.6315	.0016	8.68***
16	PRF Aggression Score	.7955	.6328	.0013	8.08***
17	PRF Affiliation Score	.7974	.6359	.0031	7.60***
18	PRF Autonomy Score	.7995	.6392	.0034	7.19***
19	PRF Impulsivity Score	.8003	.6404	.0012	6.75***
20	Total Accidents in Past 12 Mo.	.8004	.6407	.0003	6.33***
21	Age	.8005	.6408	.0001	5.95***
22	PRF Understanding Score	.8006	.6409	.0001	5.60***

*$p \leq .05$
**$p \leq .01$
***$p \leq .001$

TABLE 3—14

Results Of Stepwise Regression For Total Violations Per Mile

Order of Selection	Variable	Multiple R	R^2	Increase in R^2	F For Regression
1	Total Driving Accidents	.3414	.1165	.1165	11.87**
2	Average Total Yearly Mileage	.4119	.1697	.0531	9.09***
3	Grade Point Average	.4820	.2323	.0626	8.88***
4	PRF Social Recognition Score	.5016	.2516	.0193	7.31***
5	PRF Nurturance Score	.5188	.2691	.0175	6.33***
6	PRF Order Score	.5293	.2801	.0110	5.51***
7	PRF Dominance Score	.5459	.2980	.0179	5.09***
8	PRF Endurance Score	.5621	.3159	.0179	4.79***
9	Income of Parents	.5805	.3370	.0211	4.63***
10	PRF Affiliation Score	.5889	.3468	.0098	4.30***
11	PRF Understanding Score	.5940	.3529	.0060	3.96***
12	PRF Autonomy Score	.6000	.3600	.0071	3.70***
13	Pelz-Schuman Score	.6049	.3659	.0059	3.46***
14	PRF Harm-Avoidance	.6077	.3693	.0034	3.22***
15	Total Accidents Per Mile	.6092	.3711	.0018	2.99**
16	PRF Achievement Score	.6102	.3724	.0012	2.78**
17	PRF Infrequency Score	.6112	.3736	.0012	2.60**
18	PRF Play Score	.6120	.3745	.0010	2.43**
19	PRF Exhibition Score	.6131	.3759	.0014	2.28**
20	Age	.6135	.3764	.0005	2.14*
21	PRF Impulsivity Score	.6138	.3768	.0004	2.10*
22	PRF Aggression Score	.6140	.3770	.0002	1.90*
23	Total Accidents in Past 12 Mo.	.6141	.3771	.0001	1.79*

*$p \leq .05$
**$p \leq .01$
***$p \leq .001$

psychological characteristics are consistently seen to be greater than other measures of accidents or violations, regardless of differences among such "rankings" for the four different dependent variables examined.

3.4 Drug Usage Patterns

Six major categories of drug users were identified:

1. Non-users of any illicit drug who also either abstained from or consumed very little alcohol.

2. Light marijuana users with infrequent smoking (usually only on social occasions such as parties, after exams, etc.). These subjects usually also consumed little alcohol.

3. Heavy drinkers with little or no marijuana use. Typically, "tried grass once but it didn't turn me on." These subjects were often in social fraternities on campus and were obviously not in any "drug subculture." It could be better said that they were, if anything, in more of a "beer subculture."

4. Moderate marijuana smokers, with no or very infrequent use of psychedelics (LSD, mescaline, psylocybin). These subjects were usually light consumers of alcohol.

5. Heavy and frequent users of marijuana and psychedelics, but no or very infrequent use of "speed" (amphetamines), cocaine, or opiates.

6. Heavy and frequent users of almost all illicit drugs, including underage usage of alcohol, and the usage of marijuana, psychedelics of all sorts, opium, amphetamines, heroin and cocaine.

The great majority of those reporting amphetamine ("speed") abuse claimed they took it strictly for the purpose of staying awake for extended periods of "cram" studying for exams. There were few instances of speed being taken strictly for the "rush" or pleasure effect. Instances of intravenous injection of amphetamine ("shooting up") were very rare indeed. No instances of intravenous heroin usage were reported.

Among those few reporting barbiturate abuse ("downers") the pattern seemed to be almost exclusively that of using the drug in high school in conjunction with alcohol to "get a buzz on." But almost uniformly, the use of "downers" ceased when other drugs

became available, i.e., usually marijuana. The soporific effect of barbiturates seemed to be relatively unpopular in the spectrum of drug effects. The main reason for their use seemed to be their ready availability to most of the subjects, the most frequent source of supply being the family medicine cabinet.

One trend noticed in those with an extensive prior drug history seemed to be a kind of "I've been through the mill" attitude. These subjects reported much past drug experimentation, especially with psychedelics or intravenous amphetamine in high school or early college. This period was said to be followed by a tapering off of drug-taking activity culminating in present claimed use of only marijuana or light wines. Some of the subjects claiming this pattern were quite young in relation to their alleged excessive amount of prior drug abuse.

In general, those under 21 years had a more extensive and varied pattern of drug use than those over 22 years of age. The older subjects most often expressed fears of the possible permanent mind-altering effects of psychedelics. They also tended to have a more extensive history of alcohol consumption. This, of course, might reflect the difficulty of obtaining alcoholic beverages when under 21.

The attitudes displayed concerning the taking of psychedelic drugs ranged from mystical reverence to casualness. One subject from the East Coast criticized what he felt were irresponsible actions on the part of the Midwestern drug users. He felt that psychedelics should be used carefully as a "sacrament" for purposes of insight and not taken as one might swallow a beer at a party.

3.5 Validity of Data

As is apparent from the preceding paragraphs, a major portion of the study results is based on data gathered from interviews with members of two population groupings investigated. Thus, the question of the veracity of such self-reported data is of interest, especially in regard to the usage of psychotropic drugs.

Several features were incorporated into the drug history interview to encourage frankness among the subjects. First, all subjects were volunteers who had signed a form stating in general the purposes of the study and mentioning specifically that participation would involve discussion of their drug history. This form also emphasized that all information

obtained would be held in confidence and used only for research purposes. The fact that the form was signed and presented in the clinical surroundings of the Student Health Center may also have reinforced the impression of scientific detachment.

Secondly, most of the actual interviews were conducted in a non-university facility away from the main campus area. This may have had the psychological effect of seeming remoteness from the university per se and its official records. In addition, the interviewer and subject were alone during the interview in a bland, office-type room devoid of any distracting visual stimuli which might have tended to supply response cues.

Before any information was elicited from the subject, the interviewer carefully and frankly explained the nature of the research, including its relationship to driving and traffic safety and the source of funding. The subject was again assured that no information supplied would be traceable to him by name and the anonymous numbering system used to assure confidentiality was briefly explained. Any questions which the subject had concerning the study were promptly answered to the best of the interviewer's ability.

Some subjects, of course, did exhibit some apprehension at the beginning of the interview that the study may have been a "front" or device to obtain drug use information on individuals or groups for law enforcement purposes. Questions such as, "You're not a narc (narcotics agent), are you?", while not common, were occasionally asked. Those voicing such fears were reassured of confidentiality and reminded of the voluntary nature of the study. At no time was any duress used or pressure placed on a subject for drug information.

The very openness and research-oriented nature of the study may also have contributed to frankness on the part of the subjects. The interviewer, while not significantly older than many of the subjects, was careful to maintain an air of detached, clinical neutrality throughout the interview, i.e., he neither portrayed himself as a member of the drug culture by conspicuous dress or appearance nor did he exhibit a disapproving attitude toward drug abuse. Instead, revelations both of drug abstinence and extravagant or exotic drug use were met with the same attitude of calm research interest. Subjects were supplied with a minimum of feedback or cues by the interviewer in order to minimize the phenomenon of "giving you what you want to hear." The fact that

the interviewer did not attempt to "play up" to youth culture may also have been a plus for confidence in the subjects. As one subject remarked: "You're not a narc. If you were, you'd have long hair and a beard; you wouldn't be wearing a tie and carrying a clipboard."

Of course, the possibility exists that some subjects may have attempted to exaggerate the extent of their drug use in order to impress the interviewer or to seem more "hip." The interviewer was alert to any indications of such inflation on the part of respondents. Doubts of veracity were reflected in lower numerical reliability rating. It should be said, however, that the great majority of those relating extensive drug experience did so in a matter-of-fact way without obvious embellishment.

Perhaps a more subtle form of bias among drug-taking subjects concerned their self-reported degree of impairment while driving under the influence of one or more illicit drugs. A member of the so-called "drug culture" might well think it advantageous to report minimal driving impairment while under the effect of drugs, especially if he thought it might eventually affect future drug legislation. Indeed, although comparisons were not sought, several of those reporting having driven under the influence of marijuana voluntarily stated that the resultant impairment was much less than that experienced while driving under the influence of alcohol. To minimize this bias, the questionnaire on which the interview was based deliberately avoided requiring the subject to make any comparison between the effect of illicit drugs and alcohol on driving.

Thus, while it was impossible in this study objectively to measure actual drug taking and drug-impairment driving frequencies in the college student population, it is believed that the great majority of those interviewed were candid and attempted to provide what they considered accurate self-evaluation.

3.6 Cooperation of Subjects

A key unknown factor at the start of the study was the degree to which the subjects would cooperate. The very feasibility of the research methodology was, in fact, dependent upon whether the subjects would (1) permit their blood to be tested for the presence of drugs and (2) participate in the interviews.

3.6.1 Blood Tests

As it turned out, the blood test rejection rate was even lower than expected. Out of 90 subjects who were asked to have their blood tested for drug presence, only 12 (13 percent) refused (see Table 3-15). Further, none of the 24 subjects in the experimental group refused to participate.

Seven of the C-I group subjects (i.e., those who had just had non-motor vehicle accidents) refused the blood test. Most of the refusals were from those who objected to having blood drawn or were too shaken by their accident to be immediately receptive to the study. Thus, 90 percent of those in the E and C-I groups voluntarily submitted to the blood test even though it was not incidental to their injury treatment.

Surprisingly, the rate of refusal in the C-III group, those at the Health Center for pre-marital serologies and college entrance physicals, was higher than that of the C-I group. This meant that even though their visit to the Health Center involved giving a blood sample in any case, only 80 percent of those approached agreed to donate a small additional sample for use in the study. Accordingly, it can be said that 100 percent of the refusals in the C-III group were based on opposition to having one's blood analyzed, and not simply on fear of the needle or on fatigue.

3.6.2 Interviews

A total of 125 students were asked to be interviewed by IRPS researchers. Of these, 107 (86 percent) were interviewed. 12 of those not interviewed were the same subjects who refused the blood tests, and the other six (five percent) at first agreed to participate but were later "scratched" for a variety of reasons (they changed their minds, dropped out of school, and so forth).

TABLE 3—15

Participation In LID Study

		Group				
		E	C-I	C-II	C-III	Total
No Blood Drawn		0	7(1)	N/A(2)	0	7
Blood Drawn	Cooperated w/IRPS	24	29	29	25	107
	Rejected IRPS	0	0	0	5(1)	5
Total		24	36	29	30	119
Scratched		-	-	-	-	6
Grand Total		-	-	-	-	125

Notes: (1) Refused to participate

(2) No blood tests attempted

4.0 CONCLUSIONS

The major conclusions of the study are:

1. There was no evidence that subjects involved in traffic accidents had a greater proportion of positive blood sample drug readings than did the controls.

2. Usage *per se* of licit or illicit drugs was statistically unrelated to the number of traffic accidents and moving violations subjects had incurred in their driving lifetimes.

3. Accidents and moving violations were more strongly and consistently related to driving history, psychological, and demographic factors than they were to drug usage factors.

In addition, it is concluded that:

1. The sex of the subject was significantly related to total accidents and violations.

2. The sex of the subject was not statistically as important, however, as previous histories of accidents and violations.

3. Traffic accidents and moving violations correlated best on an overall basis with other measures of traffic accidents and moving violations. That is, number of accidents was generally better predicted by number of violations, and vice versa, than by any other independent factor.

4. The number of traffic accidents subjects had incurred was unrelated to the usage *per se* of either a) licit or b) illicit drugs, c) usage of drugs while driving, and d) degree of impairment subjects felt drugs had ever had on their driving performance.

5. Number of moving violations was more strongly related than was total traffic accidents to psychological characteristics.

6. The modal pattern of drug use was light to moderate use of marijuana with no or slight experience with psychedelics. About 75 percent of the college student subjects interviewed had used illicit drugs.

7. There was little inclination on the part of the subjects to drive under the influence of psychotropic drugs. They admitted impairment when they did drive under the influence of such drugs.

In the judgment of the subjects themselves, such impairment was usually severe in the case of psychedelic drugs, and speed and agressiveness were increased among those driving under the influence of amphetamines.

8. It is further concluded that the research methods and procedures applied in the present study were highly satisfactory and appropriate for achieving the limited objectives defined. In particular, it was found that a large fraction of both the experimental and control populations were agreeable to participation both in blood testing and in interviews. However, changes in research methodology will be required to obtain results that are more conclusive and useful for action in program planning and design.

5.0 RECOMMENDATIONS

As a result of this study it is recommended that:

1. A large-scale survey of a college student population be designed and conducted to develop statistically reliable data for describing the nature of the drug-impaired driver problem.

2. Predictive tests be developed for use by traffic law system personnel in identifying the risk posed by the college student driver.

These two recommendations are discussed below.

5.1 Large Scale Survey of College Student Drivers

The primary recommendation of this study is that a carefully designed large scale survey be conducted among a college student population to determine to an acceptable level of confidence the extent to which drug usage is a factor in motor vehicle accidents. The conceptual framework of the recommended survey would essentially be the same as for the present study, but the detailed methods and procedures would require major revisions. The survey would provide a foundation for assessing the magnitude of the drug-impaired driver problem and for developing requirements for possible action programs against such drivers.

The heart of the recommended study would be an extended comparative survey of (1) college student drivers just involved in motor vehicle accidents and (2) college students driving motor vehicles during the same time periods as the first group. Blood tests to determine drug presence would be performed on the subjects of both groups much in the same manner as in the present study. The major difference, however, would lie in the sample size and in the selection of controls. In order to obtain statistically useful results, sample sizes of the order of several hundred would be required for each group. Further, control group data should be obtained through roadside surveys similar to those being conducted in the present Alcohol Safety Action Program (ASAP). Special care would have to be exercised in the sampling procedure in order to avoid biasing the results.

5.2 Predictive Tests for College Student Drivers

The present study provided a strong indication that relationships exist between demographic, psychological, and driving history factors and motor vehicle accidents. It is recommended that these relationships be developed further to determine if operationally useful tests can be designed for risk identification by traffic law system personnel. If such predictive tests appear promising, then they should be tested in a model jurisdiction to determine their applicability to traffic law systems in general.

The data required for developing the tests could best be provided by refining the techniques and instruments used in the present study and applying them to a population size of the order of magnitude of a thousand students. The resulting much larger quantity of data would allow the application of a variety of sophisticated analytical techniques to reliably determine the relationship of drug usage and other factors to motor vehicle accidents.

APPENDIX A

A REVIEW OF THE LITERATURE

1.0 LITERATURE REVIEW

The professional literature in the areas pertinent to this study is, at best, weak and incomplete. In a recent review, Waller (55) emphasizes some of the problems existing; even this article lacks completeness and, inadvertently, points out the gross deficiencies of the area. We shall first review the literature, then critique the approaches used with an attempt to point out specific weaknesses and confounding variables.

For the purposes of this review, the literature may be divided into five categories: anecdotal studies, epidemiological studies based on driving records and illegal drug use, epidemiological studies based on post mortem analysis of accident fatalities, psychomotor studies, and driving simulator studies.

1.1 Anecdotal Studies

Several reports in the literature state that a person said he was (or was alleged to be) under the influence of a certain drug, or that to drive under the influence of a certain drug would be dangerous. Among these sources, Klein et al (26) report observations of two experienced marijuana smokers who drive through Miami while "stoned." Both reported difficulty concentrating on the task of driving, some weaving across lanes, and experiencing minimal inclines and declines as very steep grades. Many of their other subjects reported on the basis of past experience, the same difficulty concentrating while driving, as well as difficulty judging time. There was a difference in opinion as to whether drivers of private automobiles should be allowed to drive while under the influence of marijuana. Only 23 percent of former users, and 79 percent of chronic users would allow driving under the influence. Hollister (17), in his review of marijuana effects, reports that when his subjects were "high" he asked them if they thought they could drive a car then and he reports that without exception the answer was "No" or "You must be kidding."

McGlothin and Arnold (34), in a 10-year follow-up of 247 persons who had used LSD, report one case of an accident due to this drug, caused in this case by a "flashback" which occurred while driving. Wolfe (57) also reports an auto accident while the subject was directly under the influence of LSD.

introducing a bias against the illegal drug users. It seems curious that citations for speeding, failure to stop, and failure to yield were under-represented in the records of illegal drug users. In contrast to the New York study of Babst et al (2), the Washington study found that a small minority of illegal drug users did not account for most of the accidents. Indeed, Crancer and Quiring (8) state in summarization that "knowledge of arrests for illegal drug use would be valuable in predicting driving performance."

The study conducted by Babst et al (2) used driving records of New York heroin addicts registered with that state's Narcotic Addiction Control Commission. Approximately 20 percent of the registered addicts had a driver's license or driving records, and 77 percent had one or more accidents or convictions for violations. Contrariwise, the overall rate for accidents and violations of all New York State drivers was 20 percent. There were 1,226 males in the study who accumulated 4,500 accidents and convictions. Excluding 280 with clear records, this amounts to 4.7 accidents per man. Although this rate is far higher than normal, it is significant that about 10 percent of the addicts accounted for about 50 percent of the accidents and convictions.

Examination of the types of accidents and convictions yields some interesting data. Although six percent of the accidents involved death or injury, 17 percent were for "Failure To Answer Summons," and 0.2 percent for driving while intoxicated. There appeared to be an inverse relationship between population density, and accidents and convictions. In Manhattan, 42 percent of the addicts had no convictions or accidents on their records, while in the four other boroughs this figure was 25 percent. In the suburbs only nine to 12 percent had clear records.

The fact that 17 percent of the convictions were "Failure To Answer Summons" hints at a limitation of the study. Indeed the authors stated "...it cannot be determined if addicts who drive are dangerous due to their being under the influence of drugs, or if it is due to poor driving habits and accident-prone personalities." The representative quality of this sample of addicts is open to question, since the majority of addicts do not register with the Commission. Finally, the implication that only 20 percent of certified addicts drove because only that many had driving records or licenses also is open to question.

1.2 Epidemiological Studies Based on Driving Records and Illegal Drug Use

Three studies have examined the driving records of persons arrested for illegal drug use. All found that such persons have poor driving records. Crancer and Quiring (8) studied the official driving records of 302 persons sampled from the files of the Seattle Police Department and the entire list of active narcotic users registered with the Bureau of Narcotics in Seattle (King County), Washington. The subjects were separated on the basis of drugs used into three categories: narcotic users, "dangerous drug" users*, and marijuana users.

The accident rate for narcotic users was 29 percent higher; for dangerous drug users 57 percent higher; and for marijuana users, 39 percent higher than age and sex-matched controls. Violation rates were also greater. For example, during the period July 1, 1964 to October 1, 1967, the violation rate for "dangerous drug" users was 3.12 per driver, and for marijuana users 3.44 per driver. In contrast, the violation rate for non-drug users was 0.53. Overall, only 10.8 percent of male illegal drug users had clear driving records, while 42.1 percent of controls had clear records.

Some of the limitations to this study are acknowledged by the investigator. The data say nothing about "the large number of illegal drug users that have never been arrested." Since details of the sampling procedure are not given, no determination can be made of the representativeness in relation to those arrested for drug use. Only about one-half of the initial group of 628 had been licensed to drive in Washington and hence had readily available records. Although illegal drug users had a higher proportion of four types of violations (reckless driving, negligent driving, hit and run, and defective equipment), the nature of the experimental design** is such that control drivers with current citations for reckless or hit and run driving were excluded from the study, thus

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*Not further defined except that it "includes amphetamines, barbiturates, and hallucinogens."

**All subjects had to have a currently valid driver's license to be included in the study; however reckless and hit and run violations carry a mandatory license suspension provision. Because most of the control group are "one time" violators, eliminating potential controls with a currently suspended license will inflate the proportion of controls with clear records.

Smart et al (48) studied the driving records of 30 persons who were abusers (i.e., physically or psychologically dependent) of psychoactive drugs (barbiturates, tranquilizers, amphetamines, and alcohol) in a drug treatment clinic in Toronto. Accident rates were obtained by interviews and from official records. Both were in close agreement. The accident rates (per 10,000 miles) were compared to samples of the general population matched as to age, sex, driving exposure and experience.

The study clearly demonstrated an increased accident rate for the drug abusers, 1.9 times as high as expected, which was comparable to that for alcoholics. Contrary to what might be expected from data on alcoholics, the drug abusers had a much lower than expected number of non-collision accidents.

The results also take strange turns when the data are arranged in different ways. It is common for drug users to abuse more than one drug, and this creates problems in classification. For example, is a "speed freak" who sometimes uses barbiturates to end his "run" to be classified solely or primarily as an amphetamine abuser, or as an abuser of both amphetamines and barbiturates? Thus, even with a relatively small number of subjects, as in the study under discussion, a large variety of patterns of abuse may be present. Smart et al (48) chose to maximize the number of patterns by looking at all possible combinations of drugs abused. When the general category of "sedatives" was considered, there were 17 subjects who abused such drugs, with patterns of use including both alcohol and barbiturates, barbiturates only, both barbiturates and tranquilizers, or tranquilizers only. Of these 17 subjects, only four had been involved in accidents compared to an expected 6.3 subjects. There were five subjects who abused both alcohol and tranquilizers (either with or without the further addiction of barbiturates). Three times as many subjects in this group had accidents as predicted (Observed = five; Expected = 1.6). If the data are rearranged to examine all abusers of a tranquilizer (regardless of what other drugs they might or might not have also abused) such abusers were involved in four times as many accidents (Observed = nine; Expected = 1.8). Considering in the same fashion as in tranquilizers, all amphetamine abusers, there also appears a significantly greater number of accidents (Observed = 11.1; Expected = 3.0).

When histories of drug ingestion within 12 hours prior to the accident are obtained, amphetamine abusers again stand out.

Six of the eight drivers had taken amphetamines shortly before driving. In contrast, two of the four who used alcohol with or without tranquilizers had taken drugs prior to their accident, and none of those in the alcohol and barbiturates, alcohol only, or tranquilizers only groups had used drugs in that time period. Thus, the drug abuser group as a whole had a worse accident rate, due primarily to the contributions of the amphetamine abusers.

The authors also speculated as to why amphetamines should be so linked to accidents, whereas those using alcohol and barbiturates, barbiturates only and tranquilizers only had fewer accidents. It was felt that the latter group, being sedatives, may make people sleepy, lethargic, and perhaps inhibit the desire to drive. Amphetamines, in contrast, may raise motor activity and thereby promote increased driving after their ingestion. Accidents might also be related to the drug's occasional effect of creating irritability, impatience, and aggressiveness. Waller (54) touches briefly on this point in an article concerned with chronic medical conditions and driving. Out of 2,672 persons studied in California, 352 had been convicted for "drug usage." For the 306 males, the observed accident rate was 8.6 per million miles, compared to an expected rate (for a control group) of 8.4. In contrast, observed violations were 6.4 per 100,000 miles, compared to an expected rate of 3.6. Waller speculates that the high violation rates may be "a reflection of the social rebellion that drives these people to the use of drugs, rather than a reflection of the effects of the drugs per se." It is noted that many of these California drivers first came to the attention of the Department of Motor Vehicles because of their high violation rates, and only later because of their drug use.

1.3 Epidemiological Studies Based on Post Mortem Analysis

Several studies have been based upon post mortem analyses of blood and other tissues from the drivers of fatal accidents. In some cases, large numbers of bodies have been examined, and all such cases have intrinsic value in demonstrating that drugs are in the body while driving occurs. Unfortunately, few studies are useful for more complex conclusions.

There are a variety of reasons for this limited usefulness. Most studies look only for a limited number of drugs. Alcohol, barbiturates, and carbon monoxide are commonly determined; tranquilizers of different types may or may not be determined. Amphetamines are rarely looked for (although "stimulants," i.e.,

caffeine, are), and no study has attempted to find LSD, marijuana, or other drugs popular with hallucinogen users. Compounding the problem is the fact that in some cases the analytical procedures are sensitive only to large amounts of a given drug. A lesser reason is that studies completed before the first "Acid Test" in the fall of 1965 (57) in which an isolated West Coast group of hallucinogen users introduced these drugs to the populace at large reflect an older, pre-psychedelic pattern of drug use and drug abuse.

The most serious limitation of these studies is that none attempt to quantitate the amount of drug (other than alcohol) present. There is a tremendous difference between a blood alcohol level (BAC) of 30 mg. percent and 170 mg. percent, but a simple report that a given tranquilizer was "present" could mean either a fatal amount or an insignificant amount. Even if it were possible to quantitate the blood level of a given drug, for most drugs the significance of a given blood level is not known. What, for example, is the significance and degree of impairment associated with a blood level for delta-9-tetrahydrocannabinol of 75 microgram percent?

In 1967, the State of California issued a report on the role of alcohol, drugs, and organic factors in single vehicle accidents (6). Out of 1,474 fatal accidents, 772 drivers were studied for drugs, the others being lost, mostly due to technical lapses. The drugs which could be detected were barbiturates, tranquilizers, "stimulants" (caffeine), and anti-infectives. Drugs not tested for included addicting drugs such as heroin, as well as "...LSD, banana peels, or morning glory seeds." Of the 772 drivers, 13 percent (102 cases) were positive for drugs. In 62 of the 102 cases (61 percent) the BAC was 100 mg. percent or greater, whereas in 32 (31 percent) it was zero. In three cases which were positive for barbiturates, the BAC was 80-100 mg. percent, a situation in which synergism might reasonably be invoked as relevant to the accident. That is, either the barbiturates or alcohol alone might not have caused the accident.

Immediately following the California study was a more specific one by Finkle (11), based upon an analysis of over 10,000 routine drinking driver investigations which occurred in Santa Clara County, California. Although it was reported that 2,559 cases involved drugs, most of these were determined on the basis of questioning by the arresting officer rather than laboratory procedures. Of these, 1,406 were drugs requiring a prescription.

Out of the above cases, 700 were chemically analyzed for drugs, with 22 percent (159 cases) being positive. In a preliminary report (12) the basis for selecting most of the cases for analysis was stated to be signs of overt intoxication with a BAC less than 150 mg. percent. It was felt that overt intoxication at levels less than 150 must indicate the presence of an additional drug. (The fact that young people inexperienced in the use of alcohol may become intoxicated at much lower levels does not seem to have been considered.) Such a procedure will, on the one hand, ignore those users who are not intoxicated, overtly or otherwise, but who are quite possibly much more numerous. On the other hand it is almost exclusively selective of those who are affected by a drug.

Of the 159 positive specimens, almost half were barbiturates, glutethimide, or meprobamate. Sixty percent of the positive findings were in association with a BAC of 50 mg. percent or less; six percent of the cases were negative for alcohol. Expressed another way, out of 700 subjects, most of whom were overtly intoxicated but had BACs less than 150 mg. percent, 12 percent had both positive evidence for the presence of drugs and a BAC less than 50 mg. percent. (Major tranquilizers are not listed. It is not indicated if this is because none were found, or because the analytical procedure was not capable of detecting them.)

In contrast to the California work, studies in the East have found less evidence of drugs. Sunshine (49) tested a representative sample of autopsy cases in Cuyahoga County (Cleveland). Of the 950 cases, 7.5 percent (70 cases) had absorbed some barbiturates. Exactly half of these had died of natural causes and only "therapeutic levels" were detected. When fatal vehicular accidents were considered (which accounted for 10 times as many deaths in the series as barbiturates) in no case were any barbiturates found. In 42 percent of the accidents, however, ethyl alcohol was present. A subsequent study 12 years later (50) involving 147 cases in Philadelphia and Cuyahoga County, had similar results. Glutethimide and meprobamate were not detected in any blood samples; barbiturates were found in two samples in Philadelphia and none in Ohio. Phenothiazines were not detected in any cases, but this test was done on urine specimens, which were not obtained for all cases. Davis and Fisk (9) reported the results of ultraviolet spectroscopic determination for alcohol, carbon monoxide, barbiturates, amphetamines, and other drugs on fatal auto accident victims in Dade County (Miami), Florida. Out of 179 drivers tested, only

4.5 percent (eight cases) were found to have chemical evidence of the presence of a drug. The highest level detected was two mg. percent of glutethimide in association with 80 mg. percent alcohol. In this case, a synergistic effect might have been present. In the only two cases with appreciable levels of barbiturates, very high levels of alcohol were also present. Similarly Braunstein et al (4) report that out of 188 operator fatalities analyzed in Suffolk County (Long Island), New York, only three had significant levels of drugs. Two were barbiturates and one dipenylhydantoin. (Thin layer and gas chromatography were used to analyze for all possible drugs.)

Three other studies should be mentioned, though their applicability to the American scene may be limited. A United States Army in Europe (51) fatal motor vehicle study investigated 540 fatal accidents and analyzed 90 of the deceased drivers for narcotics, barbiturates, tranquilizers, antihistamines and amphetamines. A significant number of the subject drivers had histories suggestive of behavioral or personality disorders, and two-thirds of the specimens contained ethyl alcohol. Drugs were not detected in any of the cases. However, the methods used were only capable of detecting very high concentrations of drugs. Gupta and Kofoed (15) in Ontario analyzed urine and blood samples of persons charged with driving under the influence of drugs. The number of cases positive for barbiturates, in which no alcohol was found, rose from one in 1958 to 18 in 1964. The comparable figures for tranquilizers (all types) rose from zero in 1958 to seven in 1964. Wagner (52), in Germany, questioned 2,000 persons who had been in accidents, driving erratically, or stopped as routine controls. Sedatives were used most frequently in the age group 25-40 (27 percent) and 40-60 (33 percent). In this group, the percentage of accidents was found increased (77 percent).

Two surveys of psychotherapeutic drug use among adults are frequently mentioned. Manheimer et al (35) presented the results of a field test in California of what is eventually to be a detailed study. However, the significance of these findings is difficult to assess because of the way the data are combined. For example as "stimulants" they include amphetamines, caffeine preparations and tricyclic antidepressants. Milner (39) surveyed 753 general practice and psychiatric patients in Australia. He found "psychotropic" drugs (mostly phenothiazines, sedatives, and minor tranquilizers) prescribed for 74 percent of 564 patients attending psychiatric clinics, and 8.5 percent of 4,020 general practice

patients. Of the males using such agents, 85 percent also drank, 60 percent were licensed to drive, and 57 percent were at risk for both drinking and driving. The corresponding figures for women were 71 percent, 42 percent and 35 percent.

1.4 Psychomotor Studies

A favorite method used to study drug effects on performance utilizes any of a variety of psychomotor tests. In general, all such tests set out a task which the subject must accomplish by observing and analyzing the problem for the proper sequence of activity, and simultaneously carrying out the proper motor activity.

Pearson (43) compared the effects of therapeutic doses of diphenhydramine (50 mg.) or dimenhydrinate (100 mg.) to a placebo. The subjects were 40 Air Force trainees, who had to monitor the random movements of four instrument pointers, and maintain them in their null positions by adjustments of dummy throttle, stick, and rudder controls. The two drugs have antihistamine and antinausea properties, and each caused a considerable decrease in performance, beginning about 30 minutes after taking the medication. There was no difference between the two drugs. Fatigue was probably responsible for some of the decrement observed over the four hour task, since even the placebo scores worsened with time. In contrast to these results, MacKay and Ferguson (31) using RAF cadets found that the same dose (100 mg.) of dimenhydrinate failed to decrease performance of a complex coordination task. As the authors are careful to point out, their test procedure lasted only a short time, with adequate warning under challenging conditions. Nevertheless nine of the 20 subjects reported feelings of drowsiness. Another antihistamine, tripelennamine, at a typical dose of 100 mg. also failed to impair motor performance but did decrease rapid calculating ability and produced drowsiness in 10 of 20 subjects. Hughes and Forney (20) determined the effects of diphenhydramine (50 mg.) or tripelennamine (50 mg.) alone and with alcohol, on the motor performance of 16 volunteer students. The motor task was a pursuit meter, a technique in which wave patterns of varying complexity are shown on an oscilloscope, and the subject has to trace them as accurately as possible. The antihistamines alone produced no decrement in performance. Alcohol alone (BAC about 50 mg. percent) significantly impaired motor performance, but alcohol plus tripelennamine was no worse than alcohol alone. With diphenhydramine, however, alcohol produced a potentiation in two of the four tests. Curiously, although there was no actual impairment by the antihistamines alone, the subjects often reported that they felt impaired.

Zirkle et al (59) studied the effects of meprobamate (a popular minor tranquilizer) with alcohol. Twenty-two normal volunteers took 1600 mg. meprobamate a day (or placebo) for one week prior to testing. In the alcohol groups, a BAC of 50 mg. percent was obtained. A battery of eight tests were administered, two of which (digit substitution and crossing out dots) are psychomotor tests. Test scores markedly deteriorated under the different conditions. With the test scores for placebo treatment set at 100 percent, scores for the other conditions were: meprobamate 95 percent, alcohol 90 percent, and meprobamate plus alcohol 80 percent. Clinical observation supported the impression of greater intoxication in the meprobamate-alcohol treatment. Four of the subjects were obviously drunk, showing muscle incoordination and little concern for social proprieties. Two subjects could not walk without assistance. Nothing of that magnitude was seen with alcohol alone. In the same vein Huffman et al (18) showed that acute doses of 800 mg. of meprobamate (double the normal dose) significantly slowed reaction time.

Another popular minor tranquilizer, diazepam, was studied by Lawton and Cahn (28), again alone and with alcohol. Twenty subjects took 15 mg. of diazepam a day (a normal therapeutic dose) for three days prior to the experiment. The BAC for the alcohol groups was about 90 mg. percent. The psychomotor tests were Digit Substitution, Cancellation (crossing out all the letter Es in a paragraph) and a peg board test. There was a small, but statistically significant decrease in performance with diazepam compared to placebo conditions. There was no evidence to suggest a potentiating decrement with the combination of diazepam and alcohol. Ro 5-4556 (7-chloro-2,3-dihydro-1-methyl-5-phenyl-1 H-1,4-benzodiazepine hydrochloride), a chloridiazepoxide analogue and also closely related to diazepam, was tested by Bernstein et al (3). The oscilloscope pursuit meter was again used, and 16 volunteer students participated. Ro 5-4556 alone had no effect on motor performance. In combination with alcohol (BAC of 70-75 mg. percent, a "concentration below that usually associated with measurable impairment in any person") Ro 5-4556 had variable effects in motor performance. However, the overall impression was one of impairment.

Zirkle et al (58) using a procedure similar to their 1960 study described above, tested the effects of chlorpromazine, a widely prescribed major tranquilizer. Subjects utilized were both employees (N=15) and patients (N=six) at the Madison (Indiana) State Hospital. The dose was 200 mg. a day which was a common one for outpatients at the hospital. The test battery utilized

eight tests including five psychomotor tests (digit substitution, tweezer dexterity, braking reaction time, dot cancellation, and differential lever pressing). Chlorpromazine produced significant decrement in performance ($P<0.05$). The combination of chlorpromazine with alcohol (BAC about 50 mg. percent) produced an even greater impairment of performance ($P<0.0005$). Clinical observation of the subjects, and their own feelings, confirmed this. After the chlorpromazine-alcohol treatment 50 percent of the subjects reported they were sleepy, and 40 percent reported feeling intoxicated or "groggy." These percentages are twice as large as similar figures for the other three conditions combined. When asked under what condition they would be most unsafe as a driver, 87 percent of the subjects picked the day they received the chlorpromazine-alcohol combination.

Although not as widely known as the tranquilizers, the tricycle antidepressants are important chemical relatives of the phenothiazines, used in the treatment of depression. Landauer et al (27) tested the effects of acute administration of one of the tricyclics, amitriptyline, at a reasonable dose of 0.8 mg. per kg. on the motor skills of 21 volunteer medical students. The psychomotor tests were: steering wheel positioning of a pointer at a moving spot on a line, a dot tracking test, and a pursuit rotor in which the subject maintains a metal stylus in contact with a rotating disc. There was no difference between drug or double drug treatment and placebo. When alcohol (BAC about 93 mg. percent) was added, amitriptyline potentiated the deleterious effect of alcohol, especially in the double dose treatment. A few months later the same group (42) repeated the experiment, except that the volunteers took 50 mg. of amitriptyline twice a day (about the same dose) for five days prior to the experiment. This time the drug did not potentiate the alcohol effect, implying that the potentiation ability is only a liability for the first few days after the drug has been started.

As discussed earlier, amphetamine can, in some circumstances, increase psychomotor performance. Brown et al (1966) had subjects trace patterns in an oscilloscope pursuit meter for 3.5 hours. It was found that five mg. dextroamphetamine improved the performance of a simple task performed by those who had received alcohol (BAC about 50 mg. percent). It had this effect, however, only where fatigue and boredom were major factors, while in stressful situations it was not effective.

Manno et al (32) determined the effects of marijuana on the oscilloscope pursuit meter. Eight volunteer students were used as subjects. All were either experienced cigarette smokers or had had previous experience with marijuana. Each subject smoked a marijuana cigarette (or placebo) in its entirety, thereby receiving a dose of about five mg. delta-9-tetrahydrocannabinol. There was a clear cut impairment, with the mean error score for oscilloscope pattern one significantly different from placebo ($P<0.01$). The other three patterns used were all significantly different at ($P<0.05$). In terms of detecting the actual treatment received, all eight of the subjects accurately identified marijuana when it was administered, but the group split evenly on the placebo treatment. Four identified it as placebo and four as marijuana. Manno et al (33) continued this work, demonstrating the same impairment at a dose of about 2.5 mg. delta-4-tetrahydrocannabinol. When marijuana (at 2.5 and 5.0 mg.) was combined with alcohol (BAC about 50 mg. percent) there was a slight additive effect, although the scores were not significantly worse.

1.5 Driving Simulator Studies

These studies utilize a mock-up of the driver's seat, instruments, steering wheel and control devices. The subject attempts to "drive" his "vehicle" along a roadway which is projected onto a movie screen in front of him, or to "drive" a model car along a rotating belt roadway. Such devices can be very simple, measuring only the subject's ability to stay on the road, or they may be complex, measuring also his clutching and braking abilities, accelerator action, and reaction times. One model even utilizes a Lotus Formula 3 chassis and controls, and has a simulated engine noise effect which gets louder as the accelerator is pressed.

Although simulators are the most realistic approach to an actual driving situation, they are not without limitations. It is difficult to evaluate motivation. No matter how hard a driver may try to perform well, he is not without the realization that it is, after all, only a game, without serious consequences to himself if he crashes. There are also technical limitations. Some of the simulators do not allow the subject to control or alter the speed at which he is "driving." There is also an absence of the normal interaction with other traffic and pedestrians, as well as an absence of normal gravitational and other forces associated with driving, e.g. being flung to the side in a sharp turn. This not only eliminates driving feedback cues used by many drivers, but to some subjects can even be disconcerting.

Hughes et al (21) used a very sophisticated simulator to determine the effects of cyclizine, a widely used antihistamine remedy for motion sickness, available without prescription. A dose of 50 mg. (a common therapeutic dose) produced no worse performance than a placebo. Times to run 20 laps of a course and the number of errors were comparable for both conditions. Interestingly, two of the subjects reported feeling drowsy during the tests. When the same dose of cyclizine was combined with about 100 ml. of whiskey, the results were not as inocuous. Only two subjects were used, each with a BAC a little over 50 mg. percent. The time to run the 20 laps was about the same under all conditions, but the number of mistakes increased greatly with alcohol. With alcohol alone, about four times as many mistakes were made, whereas with alcohol and cyclizine only about three times as many were committed.

A favorite drug to be tested for behavioral effects is meprobamate. It is a very extensively prescribed minor tranquilizer; at one point in its history, it was predicted that a bottle of this drug would sit on every family's breakfast table, next to and analogous to the daily vitamins. Miller (38) found that 800 mg. of meprobamate (twice the normal dose) had no detrimental effect on the simulated driving of normal subjects when administered acutely. When meprobamate was administered chronically (21 to 28 days at 1600 mg./day, a normal therapeutic dose) no dependable drug effects were found. In a group of 12 anxious neurotics, 1600 mg./day gave some indications of slowed reaction time, but also decreased anxiety and tension. These results are in agreement with those of Weatherall (56) who found that 400 mg. of meprobamate resulted in either insignificant improvement or some impairment. Miller (38) combining 800 mg. of meprobamate with two ounces of 80 proof alcohol found only "some evidence of unsteadiness."

Chlordiazepoxide is another widely prescribed minor tranquilizer. Miller (38) found that after one week of 20 mg./day (a low therapeutic dose) judgment scores were poor. This meant the subjects were more likely to increase their speed with a concomitant decrease in accuracy.

Miller (38) also tested carisoprodol, a muscle relaxant, at a dose of 700 mg. per day (a normal therapeutic dose) over a two week period. There was no difference between the drug and a placebo.

Barbiturates are among the oldest sedatives, and still widely used. Weatherall (56) stated that an acute dose of 100 mg. of

quinalbarbital produced "much impairment" in a mock driver situation, for up to six hours. The short acting barbiturate amobarbital "impaired driving in a similar situation at a common hynotic dose of 100 mg. Miller (38) found that after six days of a fairly low dose of phenobarbital (30 mg. three times a day) some reaction time measures were significantly poorer.

Phenothiazines have profound importance as major tranquilizers used to treat psychotics. They are also widely used to control nausea and vomiting. Weatherall (56) reports that 50 mg. of chlorpromazine (a dose which is likely to sedate a normal person, but may have no effect on a psychotic) impaired performance in a simulator. Prochlorperazine, at a customary therapeutic dose of 10 mg., twice a day, produced no change. The same dose of the same drug was administered by Miller (38) for 21 to 28 days. He too found no significant drug effect.

Although the highly detrimental effects of amphetamine abuse on driving are well known (14) some authors (29, 40) have suggested that under certain specific conditions amphetamines may aid driving. Miller (38) found no effect on simulator performance with a normal dose of dextroamphetamine. Hauty and Payne (16) administered five mg. of dextroamphetamine to 168 airmen. Their work performance and efficiency of judgment on an aircraft simulator were monitored continuously for seven hours. The drug performance was clearly superior to the control performance, presumably due to decreased fatigue and increased alertness.

Of all the popular psychedelic drugs, only marijuana has been tested in a driving simulator, in a widely discussed experiment by Crancer et al (7). They used normal volunteers (seven females, 29 males) all of whom had valid operator licenses and were personally familiar with the intoxicating effects of both alcohol and marihuana. Three treatments were used: no treatment, alcohol ingestion sufficient to give a BAC of 100 mg. percent, and inhaling sufficient marijuana to produce a "normal social high," as judged by the subject. The conclusion of the study was that marijuana had a rather benign effect on driver simulator performance, whereas alcohol had a highly detrimental effect. Subjects "high" on marijuana accumulated significantly more speedometer errors (errors monitoring the speedometer, not actual speeding errors) than under control conditions, but other types of errors, including total errors, were not increased. In contrast, the same subjects intoxicated with alcohol made significantly more accelerator, brake, signal, speedometer, and total errors, than under normal conditions. (There were, however, no significant increases in steering errors.)

This study of Crancer et al (7) deserves further comment. The effects of marijuana apparently were not consistent, in that the authors state that about one-half the subjects in the marijuana treatment performed worse than under control conditions, but about half performed better. Since the error scores reported are means of group, the different individual scores (better and worse) under marijuana may have cancelled out leaving a net change of zero. Although it is not stated, presumably all subjects performed poorly under the influence of alcohol, or at least did not perform better. It would have been interesting to re-study the data after dividing the marijuana results (if possible) into two groups, improved and worsened. A second objection concerns a possible bias (conscious or otherwise) on the part of the subjects against alcohol and for marijuana. It is difficult to see how the subjects could have deliberately improved their scores while "high" on marijuana, but the study certainly did not guard against deliberately worsened performance while "high" on alcohol. A third objection, raised by Kalant (22) among others, concerns the comparability of the alcohol and marijuana doses. The level at which the "social high" on marijuana was obtained by a subject was decided by each subject on the basis of his subjective feelings. This could not be quantitated, or even compared among subjects. The alcohol intoxication was the same for each subject (100 mg. percent) and probably represents a BAC considerably higher than usually obtained during an "alcohol social high," which might have been a more reasonable comparison to the marijuana "social high." The study would have been much more useful had each drug been tested at three different doses.

1.6 Summary of Literature Review

1.6.1 Conclusions

The literature provides evidence that many drugs adversely affect the motor skills and judgments that are usually associated with the safe operation of a motor vehicle in a highway situation. Anecdotal studies support these findings. Yet, no study to date has shown a really sound basis for asserting that drug usage either is or is not a factor in motor vehicle accidents or violations. Epidemiological studies seem to suggest that the heavier and more frequent drug abusers have poorer driving records. However, since such studies have not attempted to account for the possible affects of a number of other pertinent variables, it cannot be said that drug abuse is itself a major factor in the accidents and violations. Thus, it must be stated that the present

literature provides no reliable basis for assessing the role of drug usage or abuse in motor vehicle accidents or violations. Some important limitations contributing to this situation are discussed below.

In consideration of the literature, a number of problems must be kept in mind. First, many studies are "acute dose" experiments, in that the subject received the medication in a single dose, 15 to 90 minutes prior to being tested. Since numerous drugs have drowsiness or sedation as a side effect, such studies commonly report impairment of behavior presumed relevant to driving. However, tolerance to drowsiness, as well as to many other side effects, commonly occurs within a few to several days. Thus, the acute studies may have questionable relevance to the case of the chronic drug user. A single dosage of 400 mg. of phenobarbital would seriously impair most persons; however, such a daily dose is quite commonly taken for years by epileptics to control their seizures, with no impairment of performance. A few studies have attempted to approximate chronic use by requiring subjects to take the drug in question from one to several days prior to the actual testing (28, 57, 58). Since this is a time when tolerance is developing, it may be of even less validity. A reasonable period to approximate chronic use would be at least two weeks.

A second problem concerns the relationship or relevancy of psychomotor tests, widely used in drug effect studies, to actual driving behavior. A simple measurement of reaction time can obviously be extrapolated to driving, but reaction times are often not slowed by drugs in clinical doses. Tests capable of detecting much more subtle drug effects have been devised, such as the pursuit meter, where the subjects ability to trace, accurately and rapidly, patterns of increasing complexity is measured. Although such tests can detect very fine decrements of motor ability, their relevance to the grosser motor skills required to steer a car may be limited.

A third complication arises when it is realized that some, perhaps many, people may perform and drive better under the influence of a drug. A person who is tense and anxious presumably cannot attend to the driving task as well as a "normal" person. A difficult, stressful day at work, followed by a struggle home in rush hour traffic, can often make for irritable and impatient driving. Under the calming influence of a minor tranquilizer, driving may become more rational (40). Beneficial effects of

drugs may even be found in amphetamines. Although the dangers of abuse of these drugs by truck drivers are well documented, they may be useful, in certain properly supervised situations, to fight off boredom and "highway hypnosis" (29, 40).

A fourth factor making applicability difficult is that no studies have attempted to evaluate ability to compensate for deleterious drug effects. A patient warned that an antihistamine may make him drowsy, can adjust his driving for the next few days to counteract any possible sedative effects. He may ask others to drive, drive only when feeling alert, or constantly remind himself that he is under the influence of a drug, and therefore must drive with extra care.

A fifth factor complicating the question is the underlying personality of the drug user. Feelings of alienation and anti-sociality may result in both drug use and poor driving, with the latter two activities being independent of each other. Pelz and Schuman have amply demonstrated that the age group 16 to 24 years, a group in which much drug abuse occurs, is also characterized by a high degree of feelings of inadequacy, anger, and frustration (44, 45, 47). In many cases these feelings are discharged through driving, with resultant poor driving records.

A sixth factor is concerned again with the possible disparity between a laboratory situation and a driving situation. A laboratory experiment can allow little leeway for errors. They must be detected and measured in order to determine the drug's effect. On the highway, there may be sufficient margin for error, that even deteriorated driving does not cause accidents. A "statistically significant" increase in reaction time may mean little if a driver is still able to stop his car before an intersection. Of course, the reverse may also be true.

Thus, the problem is far more complicated than this report may conclude. It is obvious that the current widespread use of both licit and illicit drugs, combined with the extensive operation of motor vehicles, both by "drug users" and "drug non-users" is a situation in need of extensive study.

BIBLIOGRAPHY

1. Abelson, P. H., "LSD and Marijuana," Science 159: p. 1189, 1968.

2. Babst, Dean V., James I. Inciardi, Philip K. Raeder, and Barry D. Negri, "Driving Records of Heroin Addicts," In: Committee on Problems of Drug Dependency, 1970, National Academy of Science National Research Council, New York State Narcotic Addiction Control Commission and New York State Department of Motor Vehicles, 6514-6522.

3. Bernstein, M. E., F. W. Hughes, and R. B. Forney, "The Influence of a New Chlordiazepoxide Analogue on Human Mental and Motor Performances," Journal of Clinical Pharmacology 7: pp. 330-335, 1967.

4. Braunstein, P. W., S. B. Weinberg, and L. D. Cortivo, "The Drunk and Drugged Driver Versus the Law," Journal of Trauma 8: pp. 83-90, 1968.

5. Brieglia, P. J., Toxicological Screening Program of Coroners Cases in Sacramento County.

6. California State Department of the Highway Patrol, The Roles of Alcohol, Drugs, and Organic Factors in Fatal Single Vehicle Accidents (Final Report), June, 1967.

7. Crancer, Alfred, Jr., James M. Dille, Jack C. Delay, Jean E. Wallace, and Martin D. Haykin, "Comparison of the Effects of Marihuana and Alcohol on Simulated Driving Performance," Science 164: pp. 851-854, 1969.

8. Crancer, Alfred, Jr., and Dennis L. Quiring, Driving Records of Persons Arrested for Illegal Drug Use, Administrative Services, Report 011, State of Washington, Department of Motor Vehicles, May, 1968.

9. Davis, J. H., and A. J. Fisk, "Dade County, Florida Study on Carbon Monoxide, Alcohol and Drugs in Fatal Single Vehicle Automobile Accidents," Proceedings of National Association of Coroners Seminar, pp. 197-204, 1966.

10. DeRosier, D. J., and A. Klug, "Alcohol and Amitriptyline Effects on Skills Related To Driving Behavior," Science 163: pp. 1467-1470, 1969.

11. Finkle, B. S., "Drugs in Drinking Drivers, A Study of 2,500 Cases," Journal of Safety Research 1: pp. 179-183, 1969.

12. Finkle, Bryan S., Alfred A. Biasotti, and Lowell W. Bradford, "The Occurrence of Some Drugs and Toxic Agents Encountered in Drinking Driver Investigations," Journal of Forensic Studies 13: pp. 236-245, 1968.

13. Forney, Robert B., and Frances W. Hughes, "Meprobamate, Ethanol or Meprobamate-Ethanol Combinations on Performance of Human Subjects Under Delayed Audiofeedback (DAF)," Journal of Psychology 57: pp. 431-436, 1964.

14. Fort, J. F., Statement before the Subcommittee on Health of the Committee on Labor and Public Welfare, In Control of Psychotoxic Drugs, U. S. Senate, 88th Congress, 2nd Session on S. 2628, U. S. Government Printing Office, Washington, D. C., p. 69, 1964.

15. Gupta, R. C., and J. Kofoed, "Toxicological Statistics for Barbiturates, Other Sedatives, and Tranquilizers in Ontario (A 10-Year Study)," Canadian Medical Association Journal 94: pp. 863-865, 1966.

16. Hauty, G. T., and R. B. Payne, "Mitigation of Work Decrement," Journal of Experimental Psychology 49: pp. 60-67, 1955.

17. Hollister, L. E. "Marihuana in Man: Three Years Later," Science 172: pp. 21-29, 1971.

18. Huffman, Warren, Aurelio E. Florio, Jobe L. Payne, and Floyd E. Boys, "The Influence of Two Selected Tranquilizers on Driving Skills," American Journal of Psychology 119: pp. 886-886, 1963.

19. Hughes, F. W., R. B. Forney, and P. W. Gates, "Performance in Human Subjects under Delayed Auditory Feedback After Alcohol, A Tranquilizer (Benyquinamide) or Benyquinamide-Alcohol Combination," Journal of Psychology 55: pp. 25-32, 1963.

20. Hughes, F. W., and R. B. Forney, "Comparative Effect of Three Antihistamines and Ethanol on Mental and Motor Performance," Journal of Clinical Pharmacology Therapy 5: pp. 414-421, 1964.

21. Hughes, D. T. D., F. Cramer, and G. J. Knight, "Use of a Racing Car Simulator for Medical Research. The Effects of Marzine and Alcohol on Driving Performance," Medicine, Science, and the Law, 7: pp. 200-204, 1967.

22. Kalant, H., "Marihuana and Simulated Driving," Science 166: p. 640, 1969.

23. Kennedy, R. E., C. D. Wood, Capt. A. Garybiel, and Lt. Com. R. B. McDonough, Side Effects of Some Antimotion Sickness Drugs as Measured by Psychomotor Test and Questionnaire.

24. Kibrick, Eleanor, and Reginald G. Smart, "Psychotropic Drug Use and Driving Risk: A Review and Analysis," Journal of Safety Research 2: pp. 73-85, 1970.

25. Kielholz, P., L. Goldberg, J. ImObersteg, W. Poeldinger, A. Ramseyer, and P. Schmid, "Road Traffic, Tranquilizer and Alcohol," Deutsch. Med. Wschr. 92: pp. 1525-1531, 1967.

26. Klein, A. W., J. H. Davis, and B. D. Blackbourne, "Marihuana and Automobile Crashes," University of Miami School of Medicine, Journal of Drug Issues 1: pp. 19-26, 1971.

27. Landauer, A. A., G. Milner, and J. Patman, "Alcohol and Amitriptyline Effects on Skills Related to Driving Behavior," Science 163: pp. 1467-1468, 1969.

28. Lawton, M. Powell, and Buron Cahn, "The Effects of Diazepam (Valium) and Alcohol on Psychomotor Performance," Journal of Nervous and Mental Disorders 136: pp. 550-554, 1963.

29. Leake, C. D., "The Amphetamines and the Sleepy Driver," Ohio State Medical Journal 53: pp. 176-178, 1957.

30. Loomis, T. A., and T. C. West, "Comparative Sedative Effects of a Barbiturate and Some Tranquilizer Drugs on Normal Subjects," Journal of Pharmacology and Experimental Therapeutics 122: pp. 525-531, 1958.

31. McKay, R. A., and J. K. W. Ferguson, "Influence of Certain Anti-Motion-Sickness Drugs on Psychomotor and Mental Performance," Aviation Medicine, pp. 194-195, June 1951.

32. Manno, J. E., G. F. Kiplinger, S. E. Haine, I. F. Bennett, and R. B. Forney, "Comparative Effects of Smoking Marihuana or Placebo on Human Motor and Mental Performance," Journal of Clinical Pharmacology and Therapy 115: pp. 808-815, 1970.

33. Manno, J. E., G. F. Kiplinger, N. Scholz, and R. B. Forney, "The Influence of Alcohol and Marihuana on Motor and Mental Performance," Journal of Clinical Pharmacology and Therapy 12: pp. 202-211, 1971.

34. McGlothin, W. H. and D. O. Arnold, "LSD Revisited," Arch Gen. Psychiatry 24: pp. 35-49, 1971.

35. Manheimer, D. I., G. D. Mellinger, and M. B. Balter, "Psychotherapeutic Drugs, Use Among Adults in California," California Medicine 109: pp. 445-452, 1968.

36. Marquis, Donald G., Lowell F. Kelly, James G. Milber, Ralph W. Gerard, and Anatol Rapoport, "Experimental Studies of Behavioral Effects of Meprobamate on Normal Subjects," Annals, New York Academy of Science, Volume 67-1959, pp. 701-711, 1951.

37. McFarland, R. A., and R. C. Moore, "Human Factors in Highway Safety -- A Review and Evaluation," New England Journal of Medicine 256: pp. 792-799, 837-845, 890-897, 1957.

38. Miller, James G., "Objective Measurements of the Effects of Drugs on Driver Behavior," Journal of American Medical Association 179: pp. 940-943, 1962.

39. Milner, Gerald, "Drinking and Driving in 753 General Practice and Psychiatric Patients on Psychotropic Drugs," British Journal of Psychiatry 115: pp. 99-100, 1969.

40. Neil, W. H., "Influence of Drugs on Driving," Texas State Journal of Medicine 58: pp. 92-97, 1962.

41. Nichols, James, The Effect of Drugs on Driving-Related Behavior, NHTSA draft report.

42. Patman, Joanne, Ali A. Landauer, and Gerald Milner, "The Combined Effect of Alcohol and Amitriptyline on Skills Similar to Motor-Car Driving," The Medical Journal of Australia, pp. 946-949, November 8, 1969.

43. Pearson, Richard G., "A Note on the Psychomotor Effects of Diphenhydramine Hydrochloride and Dimenhydrinate," Journal of American Pharmacologists Association, Scientific Edition 46: pp. 702-703, 1967.

44. Pelz, D. C., "Driver Motivations and Attitudes," In: Proceedings: Second Annual Traffic Safety Research Symposium of the Automobile Insurance Industry, Northbrook, Illinois, 1968.

45. Pelz, D. C., and S. W. Schuman, Young Drivers: Road Behavior and Motivations, Paper presented at Third Traffic Medicine Congress, New York City, May 29 - June 1, 1969.

46. Perry, J. G., and A. L. Morgenstern, "Drugs and Driving," Journal of the American Medical Association 195: pp. 376-379, 1966.

47. Schuman, S. H., D. C. Pelz, N. J. Ehrlich, and M. L. Selzer, "Young Male Drivers," Journal of American Medical Association 200: pp. 1026-1030, 1967.

48. Smart, Reginald G., Wolfgang Schmidt, and Karen Bateman, "Psycoactive Drugs and Traffic Accidents," Journal of Safety Research 1: pp. 67-73, 1969.

49. Sunshine, I., "The Incidence of Barbiturate Intoxication in Cases Seen at the Cuyahoga County coroner's Office," Journal of Forensic Science 1: pp. 109-118, 1956.

50. Sunshine, Irving, Nicholas Hodnett, and Fredric Rieders, "Drugs and Carbon Monoxide in Fatal Accidents," Postgraduate Medicine 43: pp. 152-154, 1968.

51. U. S. Department of the Army, "USAEUR Fatal Motor Vehicle Accident Study," Army Medical Laboratory (10th) New York APO 09180, September 1967.

52. Wagner, H. J., "Sie Bedentung der Untersuchung von Blut-bzw. Hornproben auf Arzneimittel nach Verkehrsunfallen auf Grund der Uberprufung von 2060 Personen (Significance of Urine and Blood Tests for Drugs After Accidents)," Arzneimittel/ Forschung 11: pp. 992-995, 1961.

53. Walker, Richard H., "Drugs and Driving," Memphis and Mid-South Medical Journal 37: pp. 101-105, 1962.

54. Waller, J. A., "Chronic Medical Conditions and Traffic Safety," New England Journal of Medicine 273: pp. 1413-1420, 1965.

55. Waller, Julian A., "Drugs and Highway Crashes," Journal of American Medical Association, Vol. 215, pp. 1477-1482, March 1, 1971.

56. Weatherall, M., "Drugs and the Motorist," Medico-Legal Journal 27: pp. 44-56, 1959.

57. Wolfe, T., The Electric Kool-Aid Acid Test, Farrar, Straus, and Giroux, New York, 1968.

58. Zirkle, G. A., P. D. King, B. Ott, and R. VanDyke, "Effects of Chlorpromazine and Alcohol on Coordination and Judgment," Journal of American Medical Association 171: pp. 168-171, 1959.

59. Zirkle, George A., Ott B. McAtee, Peter D. King, and Robert VanDyke, "Meprobamate and Small Amounts of Alcohol (Effects on Human Ability, Coordination and Judgment," Journal of American Medical Association 173: pp. 1823-1825, 1960.

APPENDIX B

VARIABLES USED IN THE ANALYSIS OF ACCIDENT-RELATED FACTORS

TABLE B-1: DEFINITIONS OF KEY VARIABLES

NO.	VARIABLE	VALUES	SOURCE ITEM(S)
1	Drug Usage	Have not used vs. ever used licit or illicit drugs.	21.a, 27.a
2	Drug Usage While Driving	Never driven while using drugs vs. ever driven while using drugs.	29.a
3	Drugs Influences on Driving	No drug used impaired driving vs. at least one drug used had slight, moderate, or severe impairment effect on driving.	29.b-s
4	Illicit Drug Usage	Never used cannabis, hallucinogen, stimulant, opiate, or barbituate vs. ever used	21.a
5	Illicit Drug Influences on Driving	No illicit drug used had any effect on driving vs. at least one illicit drug had a slight, moderate, or severe effect on driving.	29.b-m

Table B-1 cont.

NO.	VARIABLE	VALUES	SOURCE ITEM(S)
6	Licit Drug Usage	Never used licit drugs vs. ever used licit drugs.	27.a
7	Sex	Male vs. Female	2
8	Total Years Driving	0-2, 2.1-4, 4.1-6, 6.1-8, >8 years	9
9	Age	00-99 years	1
10	Grade Point Average (cumulative)	0.0-4.0	5.a
11	Income of Parents	$0-$99,999 per year	10.a
12	Average Total Yearly Mileage	0-99,999 Miles	8.a.2
13	MAST Score	Raw Score on Michigan Alcoholism Screening Test (0-25)	Mast Questionnaire
14	Pelz-Schuman Score	Raw Score on Modified Impulse Expression Scale (0-9)	Selected Items on Pelz-Schuman Test

Table B-1 cont.

NO.	VARIABLE	VALUES	SOURCE ITEM(S)
15	PRF Achievement Score	Raw Score on Personality Research Form Achievement Scale, Form AA (0-10)	PRF Form AA, Keyed Items
16	PRF Affiliation Score	Form AA Affiliation Scale (0-10)	PRF Form AA, Keyed Items
17	PRF Aggression Source	Form AA Aggression Scale (0-10)	PRF Form AA, Keyed Items
18	PRF Autonomy Score	Form AA Autonomy Scale (0-10)	PRF Form AA, Keyed Items
19	PRF Dominance Score	Form AA Dominance Scale (0-10)	PRF Form AA, Keyed Items
20	PRF Endurance Score	Form AA Endurance Scale (0-10)	PRF Form AA, Keyed Items
21	PRF Exhibition Score	Form AA Exhibition Scale (0-10)	PRF Form AA, Keyed Items
22	PRF Harm-Avoidance Score	Form AA Harm-Avoidance Scale (0-10)	PRF Form AA, Keyed Items

Table B-1 cont.

NO.	VARIABLE	VALUES	SOURCE ITEM(S)
23	PRF Impulsivity Score	Form AA Impulsivity Scale (0-10)	PRF Form AA, Keyed Items
24	PRF Nurturance Score	Form AA Nurturance Scale	Items as Keyed
25	PRF Order Score	Form AA Order Scale	Items as Keyed
26	PRF Play Score	Form AA Play Scale	Items as Keyed
27	PRF Social Recognition Score	Form AA Social Recognition Scale	Items as Keyed
28	PRF Understanding Score	Form AA Understanding Scale	Items as Keyed
29	PRF Infrequency Score	Form AA Infrequency Scale	Items as Keyed
30	Total Driving Accidents	00-99 Accidents (sum of Accidents during past 12, and accidents prior to past 12 months)	15, 16
31	Total Moving Violations	00-99 Violations (sum of violations during past 12, and violations prior to past 12 months)	18, 19

Table B-1 cont.

NO.	VARIABLE	VALUES	SOURCE ITEM(S)
32	Total Accidents in Past 12 Months	00-99 Accidents	15
33	Total Accidents Prior to Past 12 Months	00-99 Accidents	16
34	Total Violations in Past 12 Months	00-99 Violations	18
35	Total Violations Prior to Past 12 Months	00-99 Violations	19
36	Total Accident Per 1,000 Mile	Estimated by Dividing Total Driving Accidents by Product of Total Years Driving and Average Total Yearly Mileage. Quotient Multiplied by 1,000.	15, 16, 8.a.2, 9
37	Total Violations per 10,000 Miles	Estimated by Dividing Total Moving Violations by Product of Total Years Driving and Average Total Yearly Mileage. Quotient.	18, 19 8.a.2, 9

APPENDIX C

LID -- BLOOD ANALYSIS FINDINGS

LID -- BLOOD ANALYSIS FINDINGS

GROUP		NUMBER	
I. Cannabis	0	V. Opiates	
		morphine	2+ T in E
II. Amphetamines	0	codeine	T in C-III
amphetamine		methadone	
d-amphetamine		meperidine	
methamphetamine		propoxyphene	
pseudoephedrine		pentazocine	
ephedrine		dextromethorphan	
phenylpropanolamine		other	
methylphenidate		total number	2
phenmetrazine			
diethylproprion		VI. Antihistamines	0
phentermine		diphenhydramine	
cocaine		dimenhydrinate	
other		tripelennamine	
total number		chlorpheniramine	
		dexbrompheniramine	
III. Hallucinogens	0	promethazine	
LSD		cyproheptadine	
mescaline		other	
psilocybin		total number	
DOT			
DOET		VII. Major tranquilizers	0
DMT		chlorpromazine	
other		trifluprómazine	
total number		fluphenazine	
		perphenazine	
IV. Barbiturates		prochlorperazine	
phenobarbital		trifluoperazine	
pentobarbital		thioridazine	
sodium barbital		other	
amobarbital		total number	
secobarbital	3? all in C-III		
glutethimide		VIII. Minor tranquilizers	0
chlorol hydrate		meprobamate	
methyprylon		diazepam	
ethchlorvynol		chlordiazepoxide	
methaqualone		hydroxyzine	
other		other	
total number	3	total number	

cont.

GROUP		NUMBER	
IX. Anticholimergics	0	XI. Other	
belladonna		quinine	0
atropine		strychnime	
scopolamine		fluazepam	
other		trimethobenzamide	
total number		promethazine	
		methocarbomol	
X. Antidepressants		carisopradol	
imipramine		other	
desmethylimipramine		total groups	
amitriptyline			
nortriptyline			
protriptyline	1? E		
doxepin			
other			
total number	0		

Probable Drugs ?

Definite Drugs +

APPENDIX D

DRUG HISTORY AND BACKGROUND DATA SUMMARY

This appendix summarizes the responses to drug history and background questionnaire. Responses from both the E-group and the C-groups are included. Coding instructions follow the questionnaire.

LICIT AND ILLICIT DRUGS STUDY

DRUG HISTORY AND BACKGROUND

Group (ALL) Number

1. Age

18	19	20	21	22	23	over 23
8	25	17	20	15	7	15

2. Sex M-78 F-29

3. Reliability 1 2 3 4 5 (Circle one)

4. Year (Check one)

Frosh	25
Soph	24
Jr	21
Sr	19
Grad	17
Spec	1

5a. Cumulative GPA -

b. (Check one)

3.0 - 4.0	42
2.0 - 2.9	59
1.0 - 1.9	5
less than 1.0	0
not known	1

6. Major Concentration

(Check one)

Arts, Humanity, Music	32
Science and Math	20
Education	7
Business	22
Pre-Professional	11
Professional	3
HPER	3
Undecided	8
Other	1

7. Marital Status

(Check one)

Single	89
Married	14
Separated	0
Divorced	3
Divorced and Remarried	0
Living Together	1
Other	0

8. Average Yearly Mileage

	(1) Bloomington	(2) Total
a. Actual	-	-
(Check one in each column)		
b. Less than 5000	86	49
5000- 7500	13	8
7501-10000	3	17
10001-12500	2	5
12501-15000	0	3
Over 15000	2	22
Not Known	1	3

9. Years Driving

(Check one)

0-2	5
2.1-4	44
4.1-6	33
6.1-8	18
Over 8	7
Not Known	0

LICIT AND ILLICIT DRUGS STUDY

DRUG HISTORY AND BACKGROUND

10. Parents Yearly Income

a. Actual	
(Check one)	
b. Less than 6000	3
6000- 9000	11
9001-12000	12
12001-15000	25
15001-18000	10
Over 18000	42
Not Known	3
No Answer	1

11. Cause of Accident (Check all that apply in each column)

	(1.) Driver Report	(2.) VDP Report
a. Vehicle Defect	1	0
b. Environment	7	0
c. Driver Factor	8	0
d. Other Driver	10	0
e. Other	1	0
f. Sum	-	-
g. Not Applicable	85	91

Driver Report	(# causes checked)	0	1	2	3-5
	(frequency)	5	14	5	0

VDP Report	(#causes checked)	0	1-5
	(frequency)	24	0

12. Driver Factor (Check all that apply)

a. Inattention	6
b. Fatigue, Asleep	1
c. Distracted	1
d. Preoccupied	1
e. Drug	1
f. Alcohol	1
g. Drug & Alcohol	0
h. Poor Driving	3
i. Poor Response	0
j. Other	1
k. Sum	-
l. Not Applicable	103

E	(# factors checked)	0	1	2	3-10
	(frequency)	12	9	3	0

13. Damage (Check one)

No Damage	0
Minor	9
Moderate, Major	9
Total	4
Not Known	0
Not Applicable	85

14. Injury (Check one)

No Injury	3
Minor	16
Major	3
Death	0
Not Known	0
Not Applicable	85

LICIT AND ILLICIT DRUGS STUDY

DRUG HISTORY AND BACKGROUND

15. No. of accidents in past 12 months

0	1	2	3 or more
72	25	10	0

16. No. of accidents prior to last 12 months

0	1	2	3 or more	No Answer
62	25	7	9	3

17. In the chart below place the number of accidents satisfying the row and column heading.

1st no. = no. of people 2nd no. = no. of accidents

Severity	(1.) Damage Severity Past 12	(2.) Damage Severity Prior last 12	(3.) Injury Severity Past 12	(4.) Injury Severity Prior last 12
a. No damage/ injury	2-1	4-1;1-3 or more	23-1; 1-2	25-1;3-2;4-3 or more
b. Minor	19-1;1-2	21-1;3-2; 3-3 or more	12-1; 1-2	6-1;2-2; 2-3 or more
c. Moderate/ Major	12-1	13-1;2-2; 2-3 or more	2-1; 1-2	7-1 1-1; 1-2
d. Total/ Death	8-1	9-1	0	
e. Not Known	0	0	0	0
f. Total Number	-	-	-	-

18. No. of moving violations in past 12 months

0	1	2	3 or more
82	17	6	2

19. No. of moving violations prior to last 12 months

0	1	2	3 or more
69	26	6	6

20. In the chart below place the number of moving violations satisfying the row and column heading.

Violation	(1.) Past 12	(2.) Prior last 12
a. Speed 16	6-1	7-1;1-2
b. Speed 15	15-1;1-2	17-1;6-2;1-3 or more
c. DWI	0	0
d. Reckless	5-1	6-1
e. Stop	3-1	1-1;1-2
f. Yield	0	2-1
g. Equipment	1-3 or more	3-1
H. Other	2-1	4-1
i. Not Known	0	0
j. Total No.	-	-

LICIT AND ILLICIT DRUGS STUDY

DRUG HISTORY AND BACKGROUND

less than 18-18
18-18
19-16
20- 6
21- 8
22- 1
23- 1
No answer -39

21. In the charts below, check all that apply for each drug.

Initial Reasons for Using Drugs a. (Do not use 27)
b. Age at first use____

Reason	Cannabis	Hallucinogen	Stimulant	Opiate	Barbiturate
c. Curiosity	74	20	2	6	6
d. Rebellion	4	0	0	0	0
e. Pressure	8	2	0	0	0
f. Insight	5	5	0	0	0
g. Pleasure	21	5	2	2	1
h. Aid	0	1	1	0	0
i. Creativity	1	1	0	0	0
j. Enjoyment	22	5	2	2	1
k. Interaction	5	0	1	1	0
l. Sex	0	0	0	0	0
m. Counteraction	0	0	0	0	0
n. Other	4	2	27	1	3
o. Not Use	3	28	30	41	38

22. Current Reasons for Using Drugs a. (Do not use 29)

b. Curiosity	2	1	1	0	0
c. Rebellion	0	0	0	0	0
d. Pressure	2	0	0	0	0
e. Insight	4	4	0	0	0
f. Pleasure	50	8	1	4	0
g. Aid	2	0	0	0	0
h. Creativity	2	2	0	0	0
i. Enjoyment	44	9	1	5	0
j. Interaction	13	0	1	0	0
k. Sex	0	0	0	0	0
l. Counteraction	0	0	0	0	0
m. Other	1	2	12	1	0
n. Not Use	6	29	32	36	40

23. Preferred Drug: No Answer-75, Marijuana-22, Mescaline- 6, Opium -1, Cocaine-1, Hashish-1, LSD-1

24. Drug First Used: No Answer-39, Marijuana-61, LSD -1, Barbiturate-3, Mescaline-2, Hashish -1

LICIT AND ILLICIT DRUGS STUDY

DRUG HISTORY AND BACKGROUND

25. Location Preference for Using Drugs a. (Do not use 29)

(Check one for each location)

Location	Frequency of Use (1.) Never	(2.) Occasionally	(3.) Often	(4.) Usually	(5.) Always	No Answer
b. Private	2	2	6	31	33	33
c. Party	3	13	2	5	2	82
d. Campus	1	2	0	0	0	104
e. Public	2	6	2	2	0	95
f. Theater	1	5	0	1	0	100
g. Rally	1	0	0	0	0	106
h. Work	1	0	0	1	0	105
i. Driving	2	9	1	0	1	94
j. Other	1	0	0	0	0	106

LICIT AND ILLICIT DRUGS STUDY

DRUG HISTORY AND BACKGROUND

26. Drugs Abused - Frequency a. Not Applicable 28

Drug	A. No. Times in Past Yr Per Month	B. No. Times in Past Yr Per Yr	C. Prior to Past Yr Per month	D. Prior to Past Yr Per Yr	E. Used	F. No Longer Use
b. Cannabis	74-0 3-4 2-10 2-21 1-50 3-1 2-6 2-11 1-22 1-60 3-2 1-7 1-15 1-23 4-3 2-8 1-20 2-25				0	1
1. marijuana					12	2
2. hashish					21	1
3. other					1	0
c. Hallucinogens	2-1; 1-2				1	0
1. LSD					5	0
2. mescaline, psilocybin					4	0
3. STP, DMT, etc.					4	0
4. other					2	0
d. Stimulants	1-1; 1-4				0	0
1. amphetamine					9	0
2. cocaine					6	0
3. other					3	0
4. IV use					0	0
e. Opiates	0				0	0
1. heroin					2	0
2. Talwin®					0	0
3. Darvon®					1	0
4. other					4	0
5. IV heroin					0	0
6. IV other					0	0
f. Barbiturates	0				4	1
1. IV barbiturates					1	0
g. Anticholinergic					0	0
h. Unknown					0	0
i. Other _____					1	0
_____						0
j. Combinations					0	0
1. marijuana & EtOH					0	0
2. upper & downer					18	0
3. hall. & stim.					2	0
4. other _____					0	1
_____					6	0

LICIT AND ILLICIT DRUGS STUDY

DRUG HISTORY AND BACKGROUND

27. Drugs Prescribed - Frequency in Past Year a. Not Applicable 30

Drug	A. Daily	B. Frequently	C. Episodic More than 5	D. Episodic Up to 5	E. Used	F. No Longer Use
b. Major Tranquilizer	0	1	0	0	0	0
1. Thorazine®	0	0	0	1	0	0
2. Stelazine®	0	0	0	0	0	0
3. Mellaril®	0	0	0	0	0	0
4. Other phenothiazine	0	0	0	0	0	0
5. Other	0	0	0	0	0	0
c. Minor Tranquilizer	1	0	0	0	0	0
1. Valium®	0	3	0	0	1	0
2. Librium®	0	0	0	1	2	0
3. Meprobamate	0	0	0	0	0	0
4. Other	0	1	0	0	0	0
d. Anti-nausea	0	0	0	0	0	0
1. Phenothiazine	0	0	1	0	0	0
2. Other	0	1	0	0	0	0
e. Sleeping Medicine	0	0	0	0	1	0
1. Barbiturate	0	0	0	0	2	0
2. Other	0	1	1	2	3	0
f. Antihistamine	0	0	0	0	0	0
1. Prescription	1	7	0	6	3	0
2. Over-the-counter	0	3	4	9	7	0
g. Muscle Relaxant	0	0	0	1	3	0
h. Pain Medicine	0	0	0	0	0	0
1. Talwin®	1	0	0	1	2	0
2. Codeine	0	0	3	4	4	0
3. Darvon®	0	6	11	9	13	0
4. Fiorinal®	0	0	0	1	2	0
5. Other	0	0	0	0	3	0

LICIT AND ILLICIT DRUGS STUDY

DRUG HISTORY AND BACKGROUND

28. Drugs Abused - Effects Experienced (Use attached effect codes)

a. Not Applicable 30

Drug	A. Best Effect	B. Best Effect % of Time	C. Worst Effect	D. Worst Effect % of Time	E. Most Common Effect	F. Most Common % of Time
b. Cannabis						
1. marijuana						
2. hashish						
3. other						
c. Hallucinogens						
1. LSD						
2. mescaline, psilocybin						
3. STP, DMT, etc.						
4. other						
d. Stimulants						
1. amphetamines						
2. cocaine						
3. other						
4. IV use						
e. Opiates						
1. heroin						
2. Talwin®						
3. Darvon®						
4. other						
5. IV heroin						
6. IV other						
f. Barbiturates						
1. IV barbiturates						
g. Anticholinergic						
h. Unknown						
i. Other						
1. _____						
2. _____						
j. Combinations						
1. marijuana & EtOH						
2. upper & downer						
3. hall. & stim.						
4. other:						
5. _____						
6. _____						

LICIT AND ILLICIT DRUGS STUDY

DRUG HISTORY AND BACKGROUND

29. Drugs Affecting Driving (Use attached effect codes)

a. Not Applicable 50

Drug	(1) Effect Felt	(2) Impairment of Driving None	(3) Slight	(4) Moderate	(5) Severe
b. Cannabis	52	19	14	12	0
c. Hallucinogen	12	2	5	1	5
d. Stimulant	7	6	2	0	0
e. IV Stimulant	2	0	2	0	0
f. Opiate	1	0	0	2	0
g. IV Opiate	0	0	0	0	0
h. Barbiturate	1	0	0	1	1
i. Combination	0	0	1	0	0
j. MJ & EtOH	8	3	7	0	0
k. Up & Down	0	0	1	0	0
l. Hall & Stim	0	0	1	0	0
m. Other	0	0	1	0	0
n. Maj. Tran.	0	0	0	0	0
o. Min. Tran.	1	3	0	0	0
p. Antihistamine	5	6	0	0	0
q. Muscle Relax.	1	1	0	0	0
r. Pain Medicine	3	2	0	1	0
s. Other:	2	1	0	1	0
_____					

LICIT AND ILLICIT DRUGS STUDY

DRUG HISTORY AND BACKGROUND

30. Drugs Taken Within 48 Hours Prior to Accident (Use attached effect codes)

a. Not Applicable 98

Drug	(1) Effect Felt	(2) Effect Felt at Time 0	(3) Effect Felt at Time -1	(4) Effect Felt at Time -2	(5) Effect Felt at Time -4
b. Cannabis	5	1	0	0	3
c. Hallucinogen					
d. Stimulant					
e. IV Stimulant					
f. Opiate					
g. IV Opiate					
h. Barbiturate					
i. Combination					
j. MJ & EtOH					
k. Up & Down					
l. Hall & Stim					
m. Other					
n. Maj. Tran.					
o. Min. Tran.					
p. Antihistamine					
q. Muscle Relax.					
r. Pain Medicine					
s. Alcohol	1	1			
t. Other:					
_____					

DRUG HISTORY AND BACKGROUND

Coding for Drug Effect

GROUP A - PLEASUREABLE

1. Euphoria, "high" "stoned," "rush"
2. Relaxed, calm
3. Silly, giggly
4. Good trip
5. Other

GROUP B - DISTORTED

6. Time distortion
7. Distance, dimensions, distorted
8. Colors shimmer, glare or otherwise altered
9. Other

GROUP C - LETHARGIC

10. Lethargic
11. Weak
12. Sleepy, drowsy
13. Reflexes slowed, ataxic, slurred speech
14. Giddy, light-headed faint
15. Other

GROUP D - ENHANCED

16. More alert, awake
17. Increased ability to concentrate; thinks faster, clearer
18. Increased self-confidence
19. Increased ability to socialize
20. Enhanced sexual enjoyment
21. More creative
22. Other

GROUP E - UNPLEASANT

23. "Out of it," "spaced out" in unpleasant sense
24. Nausea, cramps, vomiting
25. Itch, rash
26. Panic, severe anxiety
27. Nervousness, anxiety agitation
28. Palpitations, breathing difficulty
29. Tremors, shake
30. Hung over
31. Dysphoric, uncomfortable
32. Other

GROUP F - NO EFFECT

33. No effect

GROUP G - OTHER

34. Other

DRUG HISTORY AND BACKGROUND

Instruction Sheet

Group -- E, C-I, C-II, or C-III
Number -- Subject number

Age -- Less than 18; 18, 19, 20, 21, 22, 23; over 23

Reliability -- 0 - Not reliable
1 - Large parts not reliable
2 - Reliable overall but some parts may be in doubt
3 - Some parts not reliable but not to a significant degree
4 - Total reliability

GPA -- If graduated, use undergrad GPA
-- Two entries: 1) actual GPA (first blank - enter a number); 2) check range where GPA falls (same applies on future items where both actual figure is called for and where a series of ranges exists.)

Major -- Check "Pre-professional" only if junior or above. For frosh and soph ask for alternate major. "Professional" = medicine, law, dentistry, optometry.

Marital -- Check divorced only if currently divorced and not remarried or living together.

Cause -- "Driver report" -- what the driver, i.e., interviewee, feels was cause.
-- "VDP report" -- VDP conclusion as to cause.
-- "Other driver" -- to be used only if other driver clearly at fault, e.g., ran stop sign.
-- "Other" -- causes not covered.
-- "Sum" -- total number of causes checked -- only significant contributory causes should be checked.
-- "Not applicable" -- not in E group, or no VDP report.

-- "Daily" -- drug used 25-31 days of the month -- ignore number of times per day.
-- "Frequently" -- used several to 24 days of each month.
-- "Episode" -- used on an acute basis for a few days at a time -- count one week (or fraction) as an episode and indicate whether subject used "up to" (and including) five episodes in previous year or more than five.
-- "Used" -- one to a few days out of each month or during previous year.
-- "No longer" -- Used prior to past 12 months but not during that 12 months.

If subject used drug for a single period of up to four months, figure as episodic usage. If greater than four months, determine frequency during that period and check "daily" or "frequently" as appropriate.

Effects Experienced

Indicate by number from the Coding for Drug Effect Sheet which predominant effect was felt for any drugs used. Subject should give "Best" and "Worst" effects, in his opinion, and "Most Common" effect. If possible the subject should estimate the approximate percent of time he experienced the "Best" and "Worst," and "Most Common" effects.

Drugs Affecting Driving

If the subject ever used any of the classes of drugs listed, while driving, this should be indicated by putting the appropriate code number of the effect felt <u>at the time of driving</u>. Note -- may be coded 33 -- no effect.

Subject should also be asked to indicate degree of driving impairment.

Drugs Within 48 Hours

"Not Applicable" -- i.e., is in one of C groups.

As above, indicate the code number of effect

felt of any drug used by E group subjects within 48 hours prior to their accident.

Subject should be asked if he felt this effect at time zero (i.e., at accident) minus 1 hour (i.e., one hour prior to accident) etc.

Reasons

-- "Do not usc" -- check if person has never used drugs (under "Initial Reasons") or does not now use drugs (under "Current Reasons").
   -- For purposes of this study alcohol is not defined as a drug.
-- "Rebellion" -- may be against parents, society, school, etc.
-- "Pressure" -- peer group pressure.
-- "Insight" -- into one's personal nature or problem; self-understanding.
-- "Pleasure" -- also relaxation, or in general a "good trip."
-- "Aid" -- to normal activity, e.g., amphetamines to help stay awake and study.
-- "Creativity" -- enhance artistic creativity.
-- "Enjoyment" -- enhanced appreciation of records, movies, environment, etc.
-- "Interaction" -- enhanced or easier social interaction.
-- "Sex" -- enhances enjoyment of sex and/or aphrodisiac.
-- "Counteraction" -- one drug used to counteract another, e.g., a downer to end a speed run.
-- "Not use" -- did not/does not use a particular drug.

Location

-- "Do not use" -- doesn't use drugs.

Question attempts to determine preference of certain locations for drug use. It is concerned with what locations are considered safe, appropriate, desirable, etc., for drug use. The subject is asked, how often he uses, or is likely to use, drugs in certain locations.

-- "Private" -- in one's own room, a friend's

room, or similar situation; alone or with a small number of friends.
-- "Party" -- informal party or dance, with at least several people, ranging from strangers to acquaintances to friends.
-- "Campus" -- on campus, between or during classes.
-- "Public" -- Where many people are likely to be, e.g., downtown or at a shopping center.
-- "Rally" -- political rally, protest demonstration, peace march, etc.
-- "Work" -- i.e., job to earn money.

Driver Factor
-- "Inattention" -- implies driver was not applying sufficient attention to task of driving.
-- "Distracted" -- by something beyond driver's control, e.g., insect or children fighting.
-- "Preoccupied" -- driver engaged in activities, e.g., thinking about argument with spouse or tuning radio.
-- "Poor driving" -- driving behavior per se inappropriate, e.g., speeding or following too closely.
-- "Poor response" -- could have avoided accident but didn't.
-- "Sum" -- total number of factors checked.
-- "Not applicable" -- not in E group, or driver factor not cause of accident.

Damage
-- "Minor" -- easily fixed, under $100.
-- "Total" -- cost as much to replace car as to repair it.
-- "Not applicable" -- not E group.

Injury
-- "Minor" -- no medical attention or treated and released (includes admit for observation).
-- "Not applicable" -- not E group.

Accidents
-- "No. accidents" -- (No. = Number) actual total number of accidents in the 12 month period previous to date subject agrees to participate, and actual total number of accidents since beginning driving to point 12 months previous to date above.

-- For E group, accident which brought them into the study is excluded from these calculations.
-- Parking lot scrapes and bumps are excluded.

-- "Damage severity" and "Injury severity" -- enter actual number of accidents for <u>each category</u> of severity.

Violations

-- "No. violations" -- same as No. accidents.
-- Only moving violations are counted.
-- Exclude equipment defects detected at annual vehicle inspections.
-- "Speed 16" -- speeding more than 15 mph over limit.
-- "Speed 15" -- speeding up to or at 15 mph over limit.
-- "DWI" -- driving while intoxicated or similar charge.
-- "Stop" -- failure to stop at stop light, stop sign, etc.
-- "Yield" -- failure to yield.

Drugs Abused

Is concerned with the use of the listed drugs for non-medical purposes. With the exception of "stimulants," "heroin," and "other" (narcotics) method of administration does not matter. (Those three have separate category for IV use; does not include "skin popping").

-- "Anti-cholinergics" -- may be a variety of drugs but most often scopolamine, as found in compounds such as Nytol, or tobacco preparations such as asthmador.
-- "Unknown" -- Any drug which subject has no knowledge as to identity but takes anyway.
-- "Other" -- fill in if subject is just an occasional user of other compounds. If frequently uses one or two particular compounds, fill in blank and check appropriately.
-- "Combinations" -- fill in if just occasionally uses combinations. If a particular combination is used frequently, check blanks appropriate and fill in blanks if necessary.
-- "Marijuana and Etoh" -- marijuana and alcohol.

-- "Upper and downer" -- stimulant and opiate or barbiturate.
-- "Hall and stim" -- hallucinogen and stimulant.
-- "No. times in past year" -- for any drug used indicate the frequency (approximate) for use within the past 12 months. May be expressed as frequency "per month" or "per year" depending on which is convenient.
-- "Prior to last year" -- for any drug used prior to past 12 months; also indicate the frequency. For variable frequency, figure the maximum rate subject ever used a drug in any given three month period.
-- "Used" -- has used prior to last 12 months, but cannot estimate frequency.
-- "No longer use" -- has used in past, but not within past 12 months.

Drugs Prescribed

Refers to drugs used for reasonable medical purposes though not necessarily obtained by prescription. Only last 12 months is of concern.

DRUG HISTORY AND BACKGROUND

Coding for Drug Effect

GROUP A - PLEASURABLE

1. Euphoria, "high" "stoned," "rush"
2. Relaxed, calm
3. Silly, giggly
4. Good trip
5. Other

GROUP B - DISTORTED

6. Time distortion
7. Distance, dimensions, distorted
8. Colors shimmer, glare or otherwise altered
9. Other

GROUP C - LETHARGIC

10. Lethargic
11. Weak
12. Sleepy, drowsy
13. Reflexes slowed, ataxic, slurred speech
14. Giddy, light-headed, faint
15. Other

GROUP D - ENHANCED

16. More alert, awake
17. Increased ability to concentrate; thinks faster, clearer
18. Increased self-confidence
19. Increased ability to socialize
20. Enhanced sexual enjoyment
21. More creative
22. Other

GROUP E - UNPLEASANT

23. "Out of it," "spaced out" in unpleasant sense
24. Nausea, cramps, vomiting
25. Itch, rash
26. Panic, severe anxiety
27. Nervousness, anxiety, agitation
28. Palpitations, breathing difficulty
29. Tremors, shake
30. Hung over
31. Dysphoric, uncomfortable
32. Other

GROUP F - NO EFFECT

33. No effect

GROUP G - OTHER

34. Other