

LABORATORY EVALUATION OF ALCOHOL SAFETY INTERLOCK SYSTEMS, VOLUME II - INSTRUMENT SCREENING EXPERIMENTS

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16. Abstract This report contains the results of an experimental and analytical evaluation of instruments and techniques designed to prevent an intoxicated driver from operating his automobile. The prototype "Alcohol Safety Interlock Systems" tested were developed both by private industry and by the Transportation Systems Center and were all drawn from a class of instruments which detect intoxication by measuring changes in the subjects ability to perform a psychomotor task. The final report consists of the following documents: Volume I, <u>Summary Report</u> - Contains an overview and summary of all the ASIS evaluation work performed through July 1972 and the results of the evaluation. Volume I is divided between the overview and an extensive appendix. Volume II, <u>Instrument Screening Experiments</u> - Contains details of the experiments conducted by the Guggenheim Center, Harvard School of Public Health, including experimental procedures, results and some preliminary data analyses. Volume III, <u>Instrument Performance at High BAL</u> - Contains the results of the experimental work performed by Dunlap and Associates, Inc., covering the performance of subjects with relatively high blood alcohol levels on selected instruments.			
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PREFACE

This study represents a research effort which utilized the staff and facilities of the Guggenheim Center for Aerospace Health and Safety at the Harvard School of Public Health, and the Transportation Systems Center of the Department of Transportation. It covers experimental work performed during the period August 1971 to April 1972.

The study was performed under the direction of Ross A. McFarland, Ph.D., Guggenheim Professor of Aerospace Health and Safety. Subjects were recruited, screened, and tested under the supervision of John A. Dougherty, M.D., and Joyce Gird at the School of Public Health. Data were analyzed by the Transportation Systems Center and Edward A. Arees, Ph.D., of the Guggenheim Center. Technical supervision from the Transportation Systems Center was provided by the project monitor, Philip Davis. Continuing review of data acquisition and analysis was provided by Donald Sussman, Ph.D., and Charles Abernethy, Ph.D., of the Transportation Systems Center. Andrew Warner provided technical assistance from the Transportation Systems Center for the interlock devices.

This report is intended to be quite comprehensive with regard to details of the recruitment, training, and testing procedures, as well as the analysis of data. However, further questions about specific aspects of the research project may be addressed to John D. Dougherty, M.D., Guggenheim Center for Aerospace Health and Safety, Harvard School of Public Health, Boston, Massachusetts, 02115. The experimental data will be kept on file by the Transportation Systems Center, Cambridge, Massachusetts, 02142.

We are indebted to the former and present Registrars of Motor Vehicles of Massachusetts, Mr. Richard E. McLaughlin and Mr. David J. Lucey, respectively. Their assistance allowed us to recruit the problem drivers who were essential to this study.

Gerald Lawrence of the Transportation Systems Center provided us with many hours of cheerful assistance during the early stages of the study. The painstaking data collection of Barry Gruber, Nancy Politzer, and Sharon Greene of the Harvard School of Public Health are reflected in the reproducible and precise data recorded during the three phases of this study. The clarity and uniformity of the many graphs are the result of the patient work of Jane Nalwald of the School of Public Health.

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1. INTRODUCTION AND SUMMARY

1.1 General Purpose

The purpose of this study was to perform laboratory testing of eight devices designed to detect alcohol intoxication in motor vehicle operators. Performance was to be measured at 0.0% blood alcohol levels and at three exposure levels planned so that blood levels would peak above 0.09%. Major goals were (1) to determine the relative effectiveness of the devices when operated by social and problem drinkers, (2) to measure correlations between performance and blood alcohol levels, and to determine intra subject and intra subject variability at various blood alcohol levels.

1.2 Phase I

1.2.1 Purpose

Phase I was a pilot study designed to determine methods of subject recruitment, training and test procedures for the various devices, method of alcohol exposure, alcohol level determinations, and subject safety.

1.2.2 Summary

Subjects were recruited from two populations, social drinkers and problem drinkers. The latter group was drawn from a list of local drivers whose licenses had been suspended for driving under the influence of alcohol.

Several problems were encountered in the process of reaching high alcohol levels while testing subjects on the various devices. The fat content of meals had to be held to a minimum in order to achieve dependable absorption of alcohol. Careful history taking of subjects' drinking experiences was found to be necessary to eliminate subjects who overestimated their capacity for drinking (only to become ill and drop out of testing). In addition, available tables for estimating the oral dose of alcohol required for a target blood alcohol level underestimated the amount needed for the first drink.

Most important, an unexpected amount of training was required to bring the subjects to a stable level of performance. Whereas most modifications of training procedures were accomplished during Phase I, the final training schedule and incentive plans were the result of continued data analysis during subsequent phases.

One of the most interesting findings during Phase I, which was also confirmed during subsequent phases, was the behavior of problem drinkers. In their interpersonal relations the problem drinkers outperformed the social drinkers at high alcohol levels. They were better behaved and more responsive to directions. On the other hand, the problem drinkers usually performed more poorly or at best no better than social drinkers when tested by the devices.

1.3 Phase II

1.3.1 Purpose

Phase II was devoted to comparative testing of each device to determine those devices which held the most promise for extensive testing. Pass-fail criteria were developed for those devices for which no such criteria were available.

1.3.2. Summary

In Phase II eight devices were tested. It soon became apparent that four devices were the maximum which the staff could efficiently test on a given day. Since four methods of testing appeared to be far superior we selected the best four devices for comparative testing in the next phase, and did not add a day of testing for the rejected devices.

All devices showed some deterioration in subject performance at the higher alcohol levels. Unfortunately this deterioration was very small or unreliable in three devices; the A. S. Dwan, Creare, and the Drunken Driver Eliminator. The A. S. Dwan device, which demonstrated somewhat poorer subject performance at high alcohol levels, did not show performance curves with a regular relationship to blood alcohol levels. More reliable changes were seen in the average performance of subjects when tested on the Creare and Drunken Driver Eliminator devices. However, the variability within and between individuals was so great as to overshadow the small difference in performance which was found.

Performance on the remaining five devices did show reliable individual deterioration in performance with increasing blood alcohol levels. Three of the more successful devices: the QuicKey, Phystester, and the Complex Reaction Tester appeared to furnish unique approaches to performance testing. Two devices, the Compensatory Tracking and Pursuit Tracking appeared to overlap in the type of performance which they tested. There was no clear advantage in the results of either tracking device, therefore the least complicated test device from the fabrication

standpoint (Compensatory Tracking) was chosen for the final group to be tested extensively. The final devices to be tested in Phase III were the QuicKey, Phystester, Complex Reaction Tester, and the Compensatory Tracking.

In addition to determining the devices which held the most promise for further testing, the data from Phase II showed a difference in performance between registry (problem drinkers) and social (social drinkers) subjects. The registry subjects performed poorer or the same as the social subjects on all devices. Poorer performance was statistically significant for results found on the Phystester and Pursuit Tracking devices. This difference on the Pursuit Tracking remained significant after controlling for age differences between these two populations.

There was no difference in performance found at the 0.05% blood alcohol level when subjects' blood alcohol levels were rising or falling. This level was the only one at which performance could be compared at equivalent rising and falling blood alcohol levels.

The average intelligence level of all subjects tested in this phase was significantly higher than in the general population. In general there were few significant correlations found between IQ and performance in Phase II. Those found explained only a very small fraction of the variability in performance on any device.

1.4 Phase III

1.4.1 Purpose

Phase III was devoted to the testing of the four most promising devices. Goals were to (1) confirm the actual performance of each device when pass-fail criteria were applied to the subject quantitative performance values, and (2) compare the pass-fail ratios of each device at various blood alcohol levels.

1.4.2 Summary

Based on their relative performance in Phase II, the QuicKey, Complex Reaction Tester, Compensatory Tracking, and Phystester devices were tested in Phase III. Criteria for pass-fail on each device were established according to the design specifications or according to their Phase II performance. Because of the small number of registry subjects tested in Phase III, the difference in performance found in Phase II between registry and social subjects could not be confirmed.

In Phase III performance again was inversely related to increased blood alcohol levels. Subjects' performance values were grouped into 4 blood alcohol levels and the percentage of failure at each level was computed for each device. While all devices showed a larger percentage of failures at high alcohol levels, the QuicKey device appeared to be the most effective. Subjects on this device failed 43.5% of the time at the highest BAQ level ($>0.09\%$) and failed only 4.2% of the time at the lowest blood alcohol level grouping ($\leq 0.03\%$).

As in Phase II the average intelligence level of all subjects tested in this phase was significantly higher than in the general population. Intelligence levels did not relate to any performance measures in Phase III of this project.

2. EXPERIMENTAL RATIONALE

Data were available which indicated the effects of alcohol on some psychological tasks. However a review of the literature indicated that a well controlled study would be required to determine the relative value of the eight devices available for testing.

2.1 Phase I

Sufficient data was not found in the literature to facilitate planning a test of these devices. Therefore a pilot study was necessary in order to develop effective subject recruitment, training, alcohol exposure, and performance testing.

2.2 Phase II

With the above techniques learned in Phase I, it became clear that certain devices were more effective than others, and that testing of all devices in depth would be wasteful. Therefore, it appeared logical to devote Phase II to an efficient screening of the devices in order to be able to identify those devices which held the greatest promise toward actual use as alcohol interlock systems.

In addition, at the onset of Phase II not enough data were available upon which to base pass-fail criteria for certain devices. Such criteria were needed to allow equal comparison with devices already developed to the stage where pass-fail standards had been determined.

2.3 Phase III

When the most promising devices were identified, they were tested according to the best available pass-fail criteria. In theory these criteria were those which would be used if the devices were installed in automobiles.

The test procedure was designed to yield data in terms of ability to screen out the intoxicated driver and also to determine the likelihood of interfering with the operation of a car driven by the sober driver. Therefore the data would show the percent of failures on each device when the subjects were at high blood alcohol levels, and the percent of failures on each device when the subjects were at zero or low blood alcohol levels.

3. EXPERIMENTAL METHODS

3.1 Phase I

3.1.1 Subjects

Selection Criteria

Subjects were selected primarily according to their tolerance for alcohol intake. It was planned to select an approximately equal number of male and female subjects with a wide distribution of ages from two populations, social and problem drinkers. Social drinkers included only those subjects who had no history of driving offense related to alcohol which resulted in an arrest. They were assumed to be light to moderate alcohol drinkers, with no problems related to the drinking of alcohol. Problem drinkers were subjects who had a history of at least one arrest for driving while intoxicated. These individuals were assumed to be heavy alcohol drinkers, with problems related to alcohol consumption.

Recruitment

Social drinkers (referred to as social subjects) were recruited by posting bulletins in nearby medical schools. It soon became apparent that many subjects who were recruited from student populations could not tolerate the higher blood alcohol levels in testing. Thereafter, heavy social drinkers were recruited at nearby bars.

Problem drinkers were recruited with the aid of the Massachusetts Registry of Motor Vehicles, who supplied a list of 240 drivers whose licenses had been suspended for driving while intoxicated. (These subjects are referred to as registry subjects.) Letters were sent out to persons on this list, explaining briefly the purpose of the study and asking that they participate. Only 41 individuals responded as being interested. Of these 19 subjects were actually scheduled for training and testing in Phases I, II, and III. (Some subjects participated in more than one phase.) Twenty-two individuals were not selected because either they were under 21 years of age, had disqualifying medical problems, were presently not using alcohol, or were unable to commit themselves to the time required for the training and testing schedule.

It was difficult to recruit women and older individuals,

therefore the population of subjects is youthful with a high proportion of males. (This is also true of Phase II and III.)

Screening

All subjects selected were previously screened over the telephone to ensure that they were:

- 1) licensed driver.
- 2) 21 years of age or older.
- 3) not on any regular medication except aspirin or oral contraceptives.
- 4) without any illnesses that might be affected by the ingestion of alcohol (i.e., alcoholism recovery, ulcers, heart condition).
- 5) currently using alcoholic beverages.

Description

A total of 31 subjects were trained and tested in Phase I. Twenty-one of the subjects were males and 10 were females. There were 5 registry and 26 social subjects. Ages ranged from 21 to 70, and the mean age was 34. A detailed description of the age distribution is given in Table I of Appendix B. The poorest corrected visual acuity for far and near vision was 20/50 and 14/20 respectively.

3.1.2 Equipment

Devices Tested

Creare

Drunken Driver Eliminator (DDE)

A. S. Dwan

Pursuit Tracking (Pursuit Track.)

Compensatory Tracking (Comp. Track.)

Complex Reaction Tester (Comp. Test)

Phystester

QuicKey

Description of Subjects' Tasks on the Devices

Creare

The subjects' task was to discriminate between a steady

and flickering light in order to determine the flicker fusion threshold. Thresholds were measured when
(1) the light first appeared to be steady, and
(2) when it first appeared to be flickering.

Drunken Driver Eliminator

The subjects' task was to turn a key (similar to an ignition key) to the right and to step on a foot pedal. His reaction time (from the time he turned the key, to the time he stepped on the foot pedal) was recorded. An incorrect response was recorded if the subject stepped on the pedal before he turned the key.

A. S. Dwan

The subjects' task was to turn a combination dial from 0 to 3, insert a key and turn it to the right 45° as fast as he could without missing the "3" marker on the combination or tripping a mechanism activated by excess contact of the edges of the key with the lock. The subject had 15 seconds to do the task and could have as many attempts as possible within this period. The number of seconds to successfully complete the task and the number of the attempts made for each repetition were recorded.

Pursuit Tracking

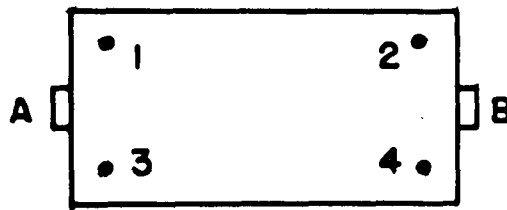
The subjects' task was to track by means of a control knob a randomly moving triangle with another triangle on a track beneath it. While the subject was performing this tracking task, a series of randomly presented images of a triangle or three dots would light up on a screen above the tracking screen. The subject would have to press one of two buttons (with his left hand) corresponding to the images of the triangle or three dots on the screen. Repetitions ran 47 seconds. Performance was measured in terms of the integrated absolute position difference between the two triangles (tracking task) and the number of correct responses to the external targets.

Compensatory Tracking

The subjects' task was to keep a pointer (which was controlled by electric circuit) centered at zero on a scale by means of a knob. Each repetition ran 43 seconds. Performance was measured by the integrated absolute position error, representing the deviation of the pointer from the center of the scale.

Complex Reaction Tester

The subjects' task was to press the right button on the panel when either the top right or bottom left light came on, and to press the left button when either the top left or bottom right light came on. (See illustration below.) Pressing the wrong button or responding in more than 0.9 seconds was recorded as an error.



- 1 When lighted- ~~subject's task was to depress A.~~
- 2 When lighted- subject's task was to depress B.
- 3 When lighted- ~~subject's task was to depress B.~~
- 4 When lighted- subject's task was to depress A.

Illustration of Subjects' Task on the Complex Reaction Tester.

Phystester

The subject pressed a button on a hand set that lit up a display on which appeared 5 digits. The subject had 1.5 seconds to memorize these numbers before they went out. Then a panel of numbered buttons (numbers 0-9), similar to a Touch-Tone telephone, was lighted. The subjects' task was to reproduce the 5 digit sequence within 3.5 seconds. Simultaneously the subject was required to watch for the word "brake," which was also illuminated on the hand set sometime during the 3.5 second interval. The subject was required to respond to this word by depressing a floor pedal within approximately 1 second. If the subject completed the double task correctly within the appropriate times, a green "start" light on the panel appeared to indicate a pass.

QuicKey

The subjects' task was to depress a small button with his thumb, and as soon as a small light adjacent to the button flashed, he was to pull his thumb away as quickly as possible. Reaction time (between light display and release of button) was recorded.

Breathalyzer

Subjects blood alcohol levels were determined by use of a Breathalyzer test device. This machine analyzes by a chemical process the amount of alcohol in an alveolar gas sample taken at the end of expiration. This gas sample is in equilibrium with the alcohol in the blood.

Titmus Vision Tester

Each subject was tested for far and near vision. Vision was determined according to the distance at which symbols could be read (in feet for far vision, and inches for near vision) based on perfect vision seeing them at 20 feet (far) and 14 inches (near).

3.1.3 Experimental Design

Particular effort was made to test these devices for their effectiveness in detection performance decrements in two populations, social drinkers and problem drinkers, for the following reasons:

- 1) Since registry (problem drinkers) subjects have had their drivers' licenses suspended for driving while intoxicated at or above the

legal limit of 0.15% blood alcohol, it was thought that their performance on the devices could be tested at this level. On the other hand, we suspected that social drinkers would not be able to tolerate such a high blood alcohol level without suffering from nausea. Only 2 registry subjects did become ill at 0.15% whereas 9 social subjects became ill or would have done so if they continued to a 0.12% blood alcohol level.

- 2) Many tests of human performance after alcohol exposure have used young college students who are social drinkers as subjects. Inclusion of this group in our study would allow a comparison with other studies and thus give some validation to the results of this study.
- 3) Problem drinkers constitute the greatest threat to driving safety in terms of property damage, serious injury, and loss of life.¹ Therefore an interlock device sensitive to decrements in their performance under high alcohol levels would be of most benefit to society and to the individual themselves. In addition, anecdotal drinkers after alcohol ingestion raised the question whether or not a device sensitive to the average social drinker would be ineffective with the problem drinker. Of course the devices could be used with more difficult pass-fail criteria but then a device designed to be sensitive to alcohol levels of problem drinkers, would be too sensitive to low alcohol levels in social drinkers. Inclusion of both groups would allow the direct testing of these issues.

All subjects were trained and tested on no more than four devices. Training was continued until a set of criteria was reached. On the same day testing was planned at control (zero) alcohol levels (Trial 1) and at three ascending blood alcohol levels (Trials 2, 3, 4). Some of the problem drinkers had demonstrable alcohol levels at the control testing session. Determinations of blood alcohol equivalent (BAQ) were planned before and after each testing session. These measures were made by the Breathalyzer.

The first two target blood alcohol levels (drinks 1 and 2) for both social and registry subjects were 0.05% and 0.10%. The final target level (drink 3) was to be 0.15% for registry

subjects and 0.12% for social subjects. Testing was planned for Trials 2, 3 and 4 at 25 minute intervals after finishing each drink. After the fourth trial it was planned to feed the subjects lunch and then test them at three hourly intervals (Trials 5, 6 and 7) as their blood alcohol levels returned toward zero.

These latter trials (5-7) were planned to measure any difference in performance between subjects when their alcohol levels were rising versus falling. Reports by Melanby indicate that blood alcohol levels may increase at a much faster rate than they decrease.² It was hypothesized that this differential rate in blood alcohol change could affect performance.

In order to motivate subjects to their peak performance and thus in some way parallel the situation where a person is trying his utmost to start his car while intoxicated, subjects were told during testing (after the control test) that their performance on the devices would affect the amount of bonus money they would earn.

3.1.4 Experimental Procedures

Training and Testing

The day started around 8:00 a.m. Subjects were briefed with regard to the hazards of the study and then were asked to sign a consent form. Their weight was taken, age recorded, and vision tested. They were then given a choice of chicken or tuna salad sandwich for breakfast with a glass of tomato juice. After breakfast subjects started training on four of the eight devices, and were finished by mid-morning. Table 1 presents the number of repetitions for training on each device.

When training was completed testing began on the devices. Table 2 presents the number of repetitions per test trials (1-7) for each device.

Shortly after finishing training subjects were tested (T_1) on the devices. All subjects then received drink one (D_1) at the same time. They were given five minutes in which to finish their drinks. Then they were tested (T_2) on the devices approximately 25 minutes later. Drink two (D_2) and three (D_3) and the past exposure tests also were administered according to the schedule above thus (T_3 and T_4) were about 1 hour apart. A BAQ was determined for each subject before and after each test session. When drinking and testing were finished subjects were given lunch. The subjects had a choice of sandwiches and any beverage that did not contain

TABLE 1. NUMBER OF REPETITIONS OF TRAINING FOR EACH
DEVICE IN PHASE I.

<u>Device</u>	<u>Number of Repetitions</u>
Creare	5
DDE	20-30
A. S. Dwan	20
Pursuit Track.	10
Comp. Track.	10
Comp. Test	16*
Phystester	25**
QuicKey	100

*2 practice sessions of 8 repetitions each.

**5 repetitions each at 5 progressively faster display and reaction times. Display time ranged from 3.0 0.7 seconds; reaction time ranged from 6.5-3.0 seconds.

TABLE 2. NUMBER OF REPETITIONS PER TEST TRIAL FOR
EACH DEVICE IN PHASE I.

<u>Device</u>	<u>Number of Repetitions Per Trial</u>
Creare	3
DDE	10
A. S. Dwan	5
Pursuit Track.	5
Comp. Track.	5
Comp. Test	8
Phystester	5*
QuicKey	30

*On three progressively faster reaction and display settings.

alcohol or caffeine. After lunch each subject was tested three times ($T_{5,6,7}$) as their blood alcohols returned toward zero. These trials were performed at hourly intervals. After all testing was finished, subjects could leave (by arranged transportation) when their BAQ had returned to 0.05% or lower.

With the above schedule four subjects per day were trained and tested, but a ten or eleven hour day was required. The same schedule was then tried with two subjects a day and the procedure could be completed more quickly, but subjects appeared to be inadequately trained and also became fatigued.

In order to increase the training of subjects a new schedule was devised. One half day was given to the training of four subjects. The following day these subjects were tested under alcohol over a period of 7 hours. The test schedule was staggered so that subjects 1 and 2 began each test session, received their three drinks, and had a BAQ determination within five minutes of each other. Subjects 3 and 4 did the same but 35 minutes later. There was on the average one hour and fifteen minutes between the administration of D_1 and D_2 , and approximately one hour and forty-five minutes between D_2 and D_3 . Subjects were now given ten minutes in which to finish their drinks. Again, subjects were tested for control (T_1), 25 minutes after each drink was finished (T_{2-4}), and three times during their recovery from peak alcohol levels (T_{5-7}). The last three tests were at hourly intervals according to the staggered schedule.

BAQs done before and after testing were averaged. However, it was not always possible to make these measures immediately before and after testing which led to confusion during rising or falling levels. Therefore we adopted the method of performing BAQ measurements in the middle of each test session.

Instructions to Subjects Before Test Day

Subjects were told not to drink any alcoholic beverages or to take any medication or use any drug after 10:00 p.m. the night before test day, and none in the morning of test day. They were also told not to have any breakfast, coffee, or tea in the morning of test day.

Subjects were told that they would not be able to drive themselves home on test day. Transportation would be provided or they could arrange for some other person to pick them up.

Motivation and Payment

Subjects received \$35 for one day of training and testing. Subjects were given \$10 for transportation home by their arrangement or by a taxi arranged by the experimenters. Subjects also could earn bonus money (received weeks later), calculated as follows:

- 1) Creare - 50¢ per test trial (2-7) could be earned. A score (mean of repetitions for each test) was passing if it were within ± 3 Hz. from the A.M. control mean score.
- 2) DDE - No bonus was paid on this task. The data were so variable that no agreement could be reached on a basis for bonus scoring. Subjects were not aware of the absence of a bonus for this device.
- 3) A. S. Dwan - 50¢ per test trial (2-7) could be earned. A score was passing if it were under 110% of the A.M. control mean score (with no lower limit). Trial scores were: total time until first success divided by the number of attempts.
- 4) Pursuit Tracking - 50¢ per test trial (2-7) could be earned. A score (mean of repetitions for each test) was passing if it were not over 110% of the A.M. control mean score (with no lower limit).
- 5) Comp. Track. - 50¢ per test trial (2-7) could be earned. A score (mean of repetitions for each test) was passing if it were not over 110% of the A.M. control mean score (with no lower limit).
- 6) Comp. Test - 25¢ per passing score on each repetition for trials (2-7) could be earned. One or less error per repetition constituted a passing score. Money could be earned during the control trial (as above) during the later part of Phase I.
- 7) Phystester - 10¢ per passing score on each repetition for all trials (1-7) and training.
- 8) QuicKey - 50¢ per test trial (2-7) could be earned. A score (mean of repetitions for each test) was passing if it were not over 110% of the A.M. control mean score (with no lower limit).

Before testing subjects were told that better performance led to higher bonuses. The mean bonus payment was \$55 with a range of \$47 to \$65.

Subjects who participated in the two day schedule received \$20 for training (one half day) and \$35 for testing. As above, they also received \$10 for providing their own transportation. Bonus money was earned and calculated as previously described. The average total earned was about \$75.

Breathalyzer

Subjects practiced giving breathalyzer samples during training day. In giving breathalyzer samples the subject rinsed his mouth then exhaled after normal inspiration and the last 1/3 of his maximal exhalation was passed into the Breathalyzer. Care was taken to ensure that subject did not contaminate the sample with a second breath. This procedure revealed those subjects who arrived for the day with a measurable amount of alcohol in their system. (One subject was dropped from the study on the morning of his training day because his blood alcohol level was measured at 0.17%.)

If a subject's BAQ reading varied widely from the expected BAQ level, then a second and if necessary, third sample, were taken until reproducible values were observed.

The breathalyzer was calibrated at weekly intervals by the use of a standard laboratory mixture of air and alcohol (Nalco Laboratories) which provided a reading of 0.10%.

Preparation of Drinks

During the first part of Phase I 100% ethyl alcohol was used in the mixing of drinks. In the latter part of this phase (and also in Phase II and III) 95% ethyl alcohol was used.

The table used to calculate the amount of cc. of alcohol for each drink is based on the Widmark Formula³ for calculating blood alcohol level:

$$C_o = \frac{A}{w \cdot r}$$

where C_o = blood concentration of alcohol at 0 time.

A = quantity of ethyl alcohol ingested (in ounces)

w = weight of person in ounces

r = $\frac{\text{concentration of water in body}}{\text{concentration of water in whole blood}}$

when denominator is 0.59 for obese,
0.77 for lean, or 0.68 for average.

Example:

- a) subject's weight: 130 lbs.
- b) to reach 0.05% level, 34 cc. of alcohol was given to subject.
- c) subject's BAQ (35 minutes after drink finished) was 0.04%.
- d) to reach 0.10% target level:
$$\frac{0.06 \text{ (increment)}}{0.10} \times 69 (0.10) = 41.4 \text{ cc.}$$
- e) subject given 41 cc. to bring his blood alcohol up to 0.10%.

Drinks were made by pouring the calculated alcohol dose into an 8 ounce paper cup and filling the rest of the cup with the subject's choice of juice. If a subject were given more than 60 cc. of alcohol in any one drink, then the drink was mixed with an extra 4 ounces of juice. Drinks were thoroughly mixed before they were presented to the subjects.

3.1.5 Discussion of Methods

The following were learned during Phase I and incorporated into the design and procedures of Phase II and III.

- 1) A training day and one full day for testing appeared to be the least amount of time required. (Further increases in training were found necessary as the data accumulated in Phase II and III.)
- 2) The optimal number of repetitions for training and testing on each device were determined. (Again subsequent accumulation of data led to further modifications.)
- 3) After finding poor tolerance for alcohol in social drinkers, these subjects were no longer recruited through student centers but rather from bars.
- 4) The second blood alcohol target level for social drinkers was reduced to 0.09% from 0.10%. This change divided the quantity of alcohol given on the first and second drink more evenly. (Subjects did not usually reach the 0.05% target level on their first drink, and as a result the second drink had

been higher in alcohol concentration than the first causing many social subjects to become nauseous.)

- 5) The BAQ determination to be taken in the middle of testing (instead of in the beginning and end). This reduced the number of BAQ tests and appeared to give an equally accurate measure of subjects' blood alcohol levels during testing.
- 6) Subjects were allowed ten minutes to drink, as the subjects suggested that the five minute drinking period led to their nausea and in some cases to their vomiting.
- 7) Breakfast was changed to a turkey sandwich with lettuce and tomato with no mayonaise in order to achieve a lower fat content. The fat content in mayonaise may have contributed to the subjects becoming ill. It might also have interfered with the reliable absorption of alcohol. Tomato juice remained as the breakfast beverage.
- 8) Subjects' safety was closely supervised on leaving (test days) by the institution of a vouchered taxi service for those who could not arrange for transportation home.
- 9) Subjects were given an intelligence test in order to test for a relation between IQ and test performance on the devices.

3.2 Phase II

3.2.1 Subjects

Selection Criteria

The selection criteria for recruiting subjects remained the same as in Phase I. (See page 6.)

Recruitment

We continued to recruit social subjects and registry subjects. Many of the social subjects recruited were referred by previous subjects.

Screening

The screening of subjects remained the same as in Phase I (see page 7) except with the following addition:

Potential subjects were asked how much, how often, and what kind of alcohol they drink. It was then explained to them that they would be given 3 drinks within 3 hours on test day. The dose for a 150 pound person would be equivalent to 7 ounces of 100 proof liquor (similar in taste to vodka) or between 5-7 mixed drinks at a public drinking place. The amount of alcohol would be graded according to the subject's weight. An individual was accepted only if he maintained that he was accustomed to drinking this amount often without becoming ill. This method appeared to yield experienced drinkers. Only 3 out of 58 subjects in Phase II did become ill while drinking. (No data were recorded subsequent to the appearance of these symptoms.)

Description

A total of 64 subjects were trained and tested in Phase II. Fifty-eight of these subjects were tested under alcohol, and the remaining 6 were tested under control conditions, that is they followed the same testing schedule but with no alcohol. Forty-nine of the subjects were males and 15 were females. There were 16 registry and 48 social subjects. Ages ranged from 21 to 62, and the mean age was 31. See Table II in Appendix B for a detailed description of the age distribution. The poorest corrected visual acuity for far and near vision was 20/40 and 14/23 respectively.

3.2.2 Equipment

Devices Tested

Creare

Drunken Driver Eliminator (DDE)

A. S. Dwan

Pursuit Tracking (Pursuit Track.)

Compensatory Tracking (Comp. Track.)

Complex Reaction Tester (Comp. Test)

Phystester

QuicKey

Description of Subjects' Tasks on the Devices

The description of the subjects' tasks are the same as in Phase I. (See pages 7-10.)

Breathalyzer and Titmus Vision Tester

These instruments were used as in Phase I. (See page 10.)

Intelligence Testing

Those subjects with a high school education or below were administered the Wesman Personnel Tests for Industry, and those with more than a high school education were administered the Wesman Personnel Classification Test. The Wesman tests were chosen because they could be administered to a group, and had both a verbal and numerical test.

Drinking History

Subjects in the last part of Phase II completed a history form designed to bring out symptoms of alcohol dependence, quantity used regularly or on occasion, and those times when alcohol played a role in some conflict with the law. This questionnaire was adapted from one created by the Highway Safety Research Institute, University of Michigan, Ann Arbor, Michigan. It was modified to allow immediate transfer to punch cards by a keypunch operator.

3.2.3 Experimental Design

During the first part of Phase II the Creare, DDE, Comp. Test, A. S. Dwan, and the QuicKey devices were tested. Training on these devices was completed in one day. The devices tested during the last part of Phase II were the

Compensatory Tracking, Pursuit Tracking, and Phystester. Training on these devices was increased to two consecutive six hour days because the data from Phase I had shown that subjects were still learning during their testing on these devices. Four subjects at a time were trained and tested. During one training day subjects were administered intelligence tests. In the last part of Phase II each subject also filled out a drinking history questionnaire.

Testing after alcohol ingestion began the day following the completion of training. Breakfast consisted of a low fat turkey sandwich with a glass of tomato juice. As in Phase I subjects were tested before any alcohol ingestion (control - T_1), thirty-five minutes after they received their three drinks ($T_2, 3, 4$) and at hourly intervals coming down in alcohol level ($T_5, 6, 7$). The testing schedule was revised so that subjects received their drinks and were tested on the devices in pairs, and one pair was thirty minutes ahead of the other pair. This type of schedule shortened the test day and was the easiest to follow. As in the last part of Phase I subjects were allowed ten minutes in which to finish their drinks. BAQ determinations were taken for each subject in the middle of each testing session. As previously explained the second blood alcohol target level for social subjects was 0.09%.

As in Phase I subjects were not allowed to leave (after testing was completed) until their blood alcohol level had dropped to at least 0.05%. Subjects' safety was supervised more closely by their personal delivery to the taxi service for those who could not arrange their own ride home. Subjects were not paid until either a friend picked them up at the testing center or until they were escorted into a taxi cab with a paid voucher.

3.2.4 Experimental Procedures

Training

Sometime during training day subjects were briefed in regard to rules for leaving on test day (blood alcohol returned to at least 0.05%, the requirements for transportation home) and how they could earn bonus money. Subjects were encouraged to bring up questions at this time. Subjects then were asked to sign a consent form. Their weight was taken and age recorded.

Training was rotated on each device. See Tables 3 and 4 for number of practice repetitions on each device. Each practice session on a device was between 10 and 15 minutes long.

TABLE 3. NUMBER OF PRACTICE REPETITIONS FOR EACH DEVICE IN THE FIRST PART OF PHASE II.

<u>Device</u>	<u>Number of Practice Repetitions</u>
Creare	5 thresholds for flicker, 5 for steady light
DDE	approximately 30
Comp. Test	minimum of 10*
A. S. Dwan	minimum of 20**
QuickKey	100

*Until subject made less than 2 errors out of 8 light displays consistently.

**Until the subject could consistently do the task in 2 to 5 seconds.

TABLE 4. NUMBER OF PRACTICE SESSIONS AND REPETITIONS PER SESSION FOR EACH DEVICE IN THE LAST PART OF PHASE II.

	<u>Device</u>	<u>Number of Sessions</u>	<u>Number of Repetitions per Session</u>
<u>First Day</u>	Comp. Track.	4	10
	Pursuit Track.	4	10
	Phystester	4*	50
<u>Second Day</u>	Comp. Track.	4	10
	Pursuit Track.	4	10
	Phystester	4**	50

*Subjects started training with a higher display and reaction time limit, such as 3.0/4.5 seconds. This was progressively decreased to criteria times (1.5/3.5) as subjects' performance improved.

**Usually at 1.5/3.5 seconds.

Subjects could rest or leave the testing room any time they desired. They were encouraged to and usually practiced on each device and then took a 10 or 15 minute rest. During training subjects were verbally praised for achieving progressively better scores. Subjects took a break from training at noon to visit rest rooms and after T_4 for lunch. Sometime near the middle of the day subjects also were administered intelligence tests, which usually took about 30-40 minutes. During scheduled rests from practice, subjects filled out the drinking history questionnaire, and also had their vision tested.

Testing

Subjects were tested under alcohol the day following the completion of training. Table 5 presents the number of practice repetitions (before control testing) and number of repetitions per test trial (1-7) for each device.

TABLE 5. NUMBER OF PRACTICE REPETITIONS (BEFORE THE CONTROL TEST) AND NUMBER OF REPETITIONS PER TEST TRIAL (1-7) FOR EACH DEVICE IN PHASE II.

<u>Device</u>	<u>Number of Practice Repetitions</u>	<u>Number of Repetitions per Trial</u>
Creare	2	3
DDE	3	10
Comp. Test	3	5
A. S. Dwan	3	5
QuicKey	10	30
Comp. Track.	3	5
Pursuit Track.	3	5
Phystester	3	3,3,3*

*At each session Phystester was tested 3 times (3 repetitions each) with 10 minutes interval between each test.

When subjects came in (around 7:45 a.m.) their weights were taken. They then ate breakfast. Subjects 1 and 2 followed the schedule below:

S_1

8:00 a.m. breakfast
8:15 BAQ
8:20 trial 1
(8:45 end test)

9:00 D_1
9:35 trial 2
9:45 BAQ
(9:55 end test)

10:00 D_2
10:35 trial 3
10:45 BAQ
(10:55 end test)

11:00 D_3
11:35 trial 4
11:45 BAQ
(11:55 end test)

Lunch

1:30 trial 5
1:40 BAQ
(1:50 end test)

2:30 trial 6
2:40 BAQ
(2:50 end test)

3:30 trial 7
3:40 BAQ
(3:50 end test)

4:30 to 5:30 (appx.)

S_2

8:00 a.m. breakfast
8:15 BAQ
8:20 trial 1
(8:45 end test)

9:00 D_1
9:35 trial 2
9:49 BAQ
(9:55 end test)

10:00 D_2
10:35 trial 3
10:49 BAQ
(10:55 end test)

11:00 D_3
11:35 trial 4
11:49 BAQ
(11:55 end test)

Lunch

1:30 trial 5
1:44 BAQ
(1:50 end test)

2:30 trial 6
2:44 BAQ
(2:50 end test)

3:30 trial 7
3:44 BAQ
(3:50 end test)

Ss blood alcohol levels were down to 0.05% and Ss departed.

Subjects 3 and 4 followed the exact same schedule but 30 minutes later than subjects 1 and 2. All subjects ate lunch at the same time. As in Phase I they could have their choice of sandwich(s) and any beverage not containing alcohol or caffeine.

After all testing was completed (about 4:30 p.m.) subjects were paid and could leave (either by taxi or with a non-subject chauffeur) when their BAQ had gone down to at least 0.05%.

Instructions to Subjects Before Test Day

Instructions remained the same as in Phase I. (See page 14.)

Motivation and Payment

Subjects who participated in one day of training and one day of testing were paid \$20 for training and \$35 for testing. Those subjects who had someone pick them up received an additional \$10. The bonus money that could be earned on the Creare, DDE, Pursuit Tracking, Compensatory Tracking, and QuicKey devices was calculated as in Phase I (see page 15). Procedures from Phase I were used to calculate the bonus money earned on the Comp. Test and the Phystester except that subjects were paid 10¢ and 20¢ per pass respectively. The procedure for calculating bonus money on the A. S. Dwan remained the same as in Phase I except that each trial score in Phase II was equal to the average time the subject successfully completed the task. Subjects were told before testing that bonus pay was calculated according to the quality of their performance. Subjects earned on the average a total of about \$55.

Subjects who participated in two days of training and one day of testing were paid a basic salary of \$30 for each day (total \$90). In addition, they could earn up to \$30 in bonus money. Half of the bonus money was calculated from the data (same as above) and the other half was determined by one of the following ratings given to each subject by the experimenter for cooperating during the three days:

Rating 1	=	\$15	most cooperative
2	=	\$8	
3	=	\$4	
4	=	\$2	
5	=	\$0	least cooperative

The majority of subjects received a rating of 1 (most cooperative). Subjects were told during their first day that they could earn bonus money by cooperating and trying to perform their best on the devices. The incentives were explained as our attempt to parallel the real situation of a person in his car trying to pass an actual ignition interlocking device so he could start his car (whether he was sober or intoxicated). Subjects could earn a possible total of \$130.00

Breathalyzer and Preparation of Drinks

The Breathalyzer test (for determining blood alcohol levels) and the preparation of drinks for target blood alcohol levels remained unchanged from Phase I (see pages 16-17).

3.2.5 Discussion of Methods

The techniques used in Phase II were satisfactory to identify the most promising ignition interlock devices. (These findings are discussed in the results section.) Nevertheless the following additional improvements in methods also became apparent during Phase II (and were incorporated into Phase III):

- 1) Whereas subjects were paid for superior performance in Phase I and II, the calculations and payment for this performance occurred after the test procedure was finished. It appeared likely that payment for superior performance would be most effective if made while testing was in progress.
- 2) Whereas individual learning scores appeared to have reached a plateau during the training session, pooled data for all subjects showed that learning continued on the test day, and therefore longer training sessions were planned for Phase III.
- 3) No data were available to indicate the consistency with which a given subject performed on the tasks. To determine the day-to-day variability in subject performance on each device, it was planned to test subjects on successive days with identical alcohol target levels during the next phase.
- 4) When using the table (based on the Widmark Formula) to calculate the quantity of alcohol in the first drink needed to bring a subject's blood alcohol level up to 0.05%, the resulting BAQ was very rarely 0.05% but usually short of this (mean BAQ being 0.03%). See Table III in Appendix B for a list of BAQs reached using the Widmark Formula. Therefore a correction standard was applied to the calculation of the first drink during Phase III.

3.3 Phase III

3.3.1 Subjects

Selection Criteria

The selection criteria for recruiting subjects remained the same as in Phase I and II (see page 6) with an additional requirement that a subject not object to having one or two blood samples taken from him on test (alcohol exposure) days.

Recruitment

We continued to recruit social subjects and registry subjects as in Phase I and II. The list of possible registry subjects was exhausted, thus only two registry subjects were trained and tested in Phase III.

Screening

The screening of subjects remained the same as in Phase I and II (see pages 7, 19) except as noted in the selection criteria.

Description

A total of 24 subjects were trained and tested in Phase III. Twenty of these subjects were tested after alcohol exposure and the remaining 4 were tested under control conditions, thus subjects followed the same testing schedule but with no alcohol. Sixteen of the subjects were males and 8 were females. There were 2 registry and 22 social subjects. Ages ranged from 21 to 28, and the mean age was 24. See Table III in Appendix C for detailed description of the age distribution of subjects. The poorest corrected visual acuity for far and near vision was 20/50 and 14/47 respectively.

3.3.2 Equipment

Devices Tested

Compensatory Tracking

Complex Reaction Tester (Comp. Test)

Phystester

QuickKey

Description of Subjects' Tasks on the Devices

The description of the subjects' tasks are the same as in Phase I and II. (See pages 7-10.)

Breathalyzer and Titmus Vision Tester

These instruments were used as in Phase I and II. (See page 10.)

Intelligence Tests and Drinking History Questionnaire

Subjects were administered the Wesman Intelligence Tests as in Phase II. All subjects in Phase III filled out the drinking history questionnaire. (See page 20.)

3.3.3 Experimental Design

The devices selected for further study in Phase III were the Compensatory Tracking, Comp. Test, Phystester, and QuicKey. Pooled data from Phase II indicated that subjects continued to learn while being tested under alcohol. Therefore, additional training was added for the devices. Training was now extended over three days for new subjects, and two days for subjects with previous training on the devices.

Pass-fail criteria for testing under alcohol exposure was established for each device. The Phystester and Comp. Test devices had pass-fail criteria which were preset to be the same for every subject. These criteria were the same for training as for testing. After training was completed, individual pass-fail scores were calculated for each subject for the Compensatory Tracking and QuicKey devices.

As in the later part of Phase II subjects could earn bonus money for cooperating during the whole study (training and testing). Basic pay for each day of participation was lowered because subjects now had the opportunity to earn up to \$42 (in tokens) by passing each trial on each device for seven test sessions.

As noted before subjects were tested three days after alcohol exposure in order to determine the consistency of subject performance. The first test day immediately followed the last day of training. The second test day was two to three days after the first, and the last test day two to three days after the second. The test day schedule was the same one followed in Phase II.

Blood samples were taken from subjects once while absorbing alcohol and once as the blood levels were dropping. These samples were analyzed for alcohol by the Leary Laboratories, Boston, Massachusetts. These values were compared with the Breathalyzer readings (taken at very nearly the same time).

Data from Phase II showed that blood alcohols of most subjects reached only 0.02% or 0.03% on their first drink. Therefore a correction was applied to the calculations of first drink of alcohol to ensure reaching the target level of 0.05%.

3.3.4 Experimental Procedures

Training

Subjects were briefed as in Phase I and II and were asked to sign a consent form. The \$20 bonus for cooperation was explained. They were also told that they would be earning tokens redeemable in money for each time they passed a repetition on each device on test days. (On the QuicKey a subject would be earning 3 tokens if he passed, zero tokens if he failed.) It was explained that the better they performed during training the greater their chances of earning tokens on test days. Subjects' weights were taken to plan the target alcohol doses. Sometime during a training day subjects were administered intelligence tests. During scheduled breaks from training on the devices the subjects filled out a drinking history questionnaire, and their vision was tested. Each practice session for a particular device lasted for 10 to 15 minutes. Tables 6 and 7 present the amount of training accomplished on each device. Subjects were encouraged to and usually did practice one session on each device and then took a 10 or 15 minute rest. During training subjects were verbally praised for achieving progressively better scores.

Pass-Fail Criteria

QuicKey

The procedure for establishing pass-fail cut off points for the QuicKey was provided by the manufacturer. Scores of the last 50 repetitions of training were plotted for each subject on a frequency histogram. The maximum allowable response time was determined by the subject's 8th lowest score. The minimum allowable response time was set by this time minus 15%.

During testing, a green light indicated the subject had passed.

TABLE 6. NUMBER OF PRACTICE SESSIONS, REPETITIONS PER SESSION, AND SESSIONS PER DAY FOR PREVIOUS SUBJECTS ON EACH DEVICE IN PHASE III.

<u>Device</u>	<u>Number of Practice Sessions</u>	<u>Number of Repetitions per Session</u>	<u>Number of Sessions per Day</u>
QuicKey	6	25	3
Phystester	8*	25	4
Comp. Track.	7	6	3,4
Comp. Test	10**	4	5

*Or until criteria of 23 passes out of 25 repetitions (at 1.5 second display time and 3.5 second reaction time setting) is reached.

**Gradually working the subject toward the test criteria of 0.9 seconds reaction time, from an initial setting of 3.6 seconds then 1.8, and finally 0.9.

TABLE 7. NUMBER OF PRACTICE SESSIONS, REPETITIONS PER SESSION, AND SESSIONS PER DAY FOR NEW SUBJECTS ON EACH DEVICE IN PHASE III.

<u>Device</u>	<u>Number of Practice Sessions</u>	<u>Number of Repetitions per Session</u>	<u>Number of Sessions per Day</u>
QuicKey	6	25	2
Phystester	24*	25	8
Comp. Track.	18	6	6
Comp. Test	10**	4	3,4

*Or until criteria of 23 passes out of 25 repetitions (at 1.5 second display time and 3.5 second reaction time setting) is reached.

**Gradually working the subject toward the criteria of 0.9 second reaction time.

Phystester

Criteria for a pass or fail score on a repetition was the same for testing as for training.

After the completion of a repetition, a green "start" light or a neutral "set" light indicated the subject had passed or failed respectively.

Compensatory Tracking

The procedure for establishing pass-fail cut-off points for the Compensatory Tracking was provided by the Department of Transportation. Mean and standard deviation of the last 36 repetitions of training were calculated for each subject. Cut off points for subjects were determined by $(1.64 \times \text{standard deviation of the mean}) + (\text{mean score})$. Any score above this was a fail score, any score below was a pass. After the first eight subjects, the procedure for obtaining the criteria score was changed to $(1 \text{ standard deviation}) + (\text{mean})$.

After a repetition was completed, a green light indicated to the subject that he had passed, while a red light indicated to him that he had failed.

Complex Reaction Tester

Criteria for a pass or fail score on a repetition was the same for testing as for training, that is, subject was allowed only one error out of a possible eight in order to pass.

At the completion of a repetition a green "pass" light indicated to the subject that he had passed, while a red "fail" light indicated that he had failed that repetition.

Test Day

Subjects were tested under alcohol the day following the completion of training. Subjects were tested a second and third day. The three test days were spaced two or three days apart from each other. Table 8 presents the number of repetitions per test trial (1-7) for each device. Subjects were not given any practice repetitions on test day, as they were in Phase II.

TABLE 8. NUMBER OF REPETITIONS PER TEST TRIAL (1-7) FOR EACH DEVICE IN PHASE III.

<u>Device</u>	<u>Number of Repetitions per Trial</u>
QuicKey	*
Phystester	3
Comp. Track.	3
Comp. Test	3

*Subjects were given 2 minutes in which to pass, with as many attempts within that 2 minutes as possible. Testing stopped when subject made a passing response.

The test day schedule was the same as in Phase II. The subjects' weights were taken at about 7:45 a.m. Then they ate breakfast consisting of a turkey sandwich with lettuce, tomato (no mayonaise) and drank a glass of tomato juice as in Phase II. Subjects received their drinks, were tested on the devices, and had BAQ determinations in pairs as in Phase II. (See page 24.)

Two subjects were chosen randomly on a given test day to have their blood samples taken. These were taken after the BAQ determination for either Trial 1, 2, 3, or 4 and again for either Trial 5, 6, or 7.

Subjects had the same requirements for leaving after testing as in Phase II.

Instructions to Subjects before Test Day

Instruction remained the same as in Phase I and II. (See page 14.)

Motivation and Payment

Subjects were paid a basic \$10 for each day of participation (total of \$50 or \$60). As a motivator during the whole study they were told they could earn up to \$20 as a cooperation bonus. This bonus was paid later and was determined by one of the following ratings given to each subject by the experimenters:

Rating 1 = \$20 most cooperative
 2 = \$16
 3 = \$12
 4 = \$8
 5 = \$4 least cooperative

This was a subjective rating and criteria used were: subjects' attitude; subjects' apparent self-motivation; and their punctuality in arriving on time. On test days subjects were awarded tokens worth 50¢ each for successful performance on each trial on each device. Up to 12 tokens (3 for each device)--\$6--could be gained in bonuses at each scheduled testing session. In theory, with 7 sessions each day, subjects could earn \$42 in bonus money (over the basic \$10). The average subject earned about \$35 in bonus tokens on a test day. In addition, as in Phase II, subjects were given \$10 on each test day they arranged for someone to pick them up. The average total earned (for 5 to 6 days) was between \$180 and \$210.

Breathalyzer

The Breathalyzer test (for determining blood alcohol equivalents) was used as in Phase I and II. (See page 16.)

The majority of Phase III was completed before the machine was calibrated, at which time it was found to read 0.12 with a test standard of 0.15%.

Preparation of Drinks

Drinks were prepared in the same way as in Phase I and II (see pages 16-17) except that a correction standard was applied to the calculation of the first drink, to ensure bringing subjects' blood alcohol levels closer to 0.05%.

Thus the formula for calculating the first drink was:

$.71 \times \text{volume of alcohol cc. to bring } \underline{s} \text{ up to } 0.10\% \text{ level}$

Using our first example (see page 17) the first drink would be calculated:

a) subject's weight: 130 lbs.

b) target level: .05%

c) calculation:

$.71 \times 69 (0.10) = 48.9 \text{ cc.}$

d) thus the subject was given 49 cc. (instead of 34) to bring his blood alcohol up to 0.05%.

3.3.5 Discussion of Methods

The blood alcohol values determined by the Leary Laboratory generally exceeded the Breathalyzer values by about the same or slightly more than that indicated by the 0.12 reading of the 0.15% test gas. An occasional determination of blood alcohol by the laboratory was clearly spurious; for example, one relatively sober subject was reported to be 0.35%. It appears necessary to calibrate the Breathalyzer often. For more reliability, only one experimenter should take the samples and readings.

The correction standard applied to the first drink was successful in bringing subjects' blood alcohol level closer to the 0.05% target level. See Table III, V, and VI in Appendix B for a comparison of subjects' BAQ levels reached when using the Widmark Formula and the correction standard.

Although the training sessions were prolonged for three days, some learning on certain tasks occurred on test days. Fortunately the amount of learning was not so great as to prevent drawing conclusions from the results. However, this finding underscores the difficulty in planning a training schedule which will ensure that subjects are completely trained. Complete training of subjects may not be practical from the logistical point of view. Or perhaps a better method of motivation, like one similar to the tokens used during testing, would ensure better performance during training.

The \$20 cooperation bonus seemed to effectively ensure the smooth running of training and testing. The majority of subjects earned the highest rating (1 = \$20). The lowest rating given was a 3 (\$12) and only 4 subjects received that rating. No way was found to ensure that everyone on our staff was satisfied that each subject was trying his hardest. It appeared that the life style of some subjects led them to reject the goals and incentive plan of this project. There was no way found to screen for these individuals. However, they do represent a certain segment of the population and as such probably should be included in the study.

The establishment of pass-fail criteria provided better feedback to the subjects and allowed an easy, fair way of paying monetary bonuses. Such a technique should be valuable to any prolonged test schedule such as that in Phase III.

4. RESULTS

4.1 Phase I - Analysis of Results and Discussion

Phase I provided important experience factors which were valuable when planning for a substantive test of the devices during Phase II. By the end of Phase I it had been established that:

- 1) Careful attention must be paid to drinking histories in order to recruit subjects who can successfully tolerate intoxicating levels of alcohol.
- 2) The first doses of alcohol should be somewhat smaller than subsequent intake in order to avoid nausea.
- 3) Most devices required considerable training which could not be given on the same day as alcohol exposure and testing.
- 4) Tables developed from the Widmark Formula for alcohol intake underestimated the amount of alcohol needed in a single dose that was required to achieve the first target level. (Table III in Appendix B.) This problem may have been aggravated by ingestion of food with a high fat content.
- 5) Wide variation was found between subjects' performance scores on the test equipment. No other measures of ability were available, but the experimenters suspected that the brighter, more aggressive subjects performed better on all trials. Therefore, it appeared valuable to obtain some objective measures of intelligence.

4.2 Phase II - Analysis of Results and Discussion

In this phase and in Phase III, except where otherwise indicated, the data were analyzed by analysis of variance (anova) after the method of Lindquist⁴ (Treatment x Subject design).

4.2.1 Creare Device

On this task, subjects had to discriminate between a steady and flickering light. Actually, the stimulus was always flickering, but the rate of flicker would reach a point at which subjects could not see it as a flickering light and would report it as being steady. The dependent variable was the frequency in Hertz (Hz.) at which the subject noticed a change from a steady to a flickering light and the reverse.

The following subjects were tested on this device:

- 18 male social subjects
- 8 female social
- 1 male registry
- 1 female registry
- 1 male control
- 1 female control

A summary of the data for the male and female social subjects is presented in Table 9 and illustrated in Figs. 1 and 2. The means for the 2 registry subjects and 2 control subjects are presented in Tables I and II of Appendix A. Because of the small number of subjects tested in these two groups, no further analyses were done on their data.

Analysis of variance for male social drinkers showed that the means for the 7 test trials were significantly different from each other ($p < 0.005$). Results of the analysis of variance are presented in Table 10.

A Tukey Wholly-Significant-Different (W-S-D) test after analysis of variance for male social subjects showed that means of Trial 1 and 2 were significantly different from means of Trials 3, 4, and 5. All other means were not significantly different from each other.

Performance by the 8 female social subjects continued to decline over trials. This suggests that performance may be decrementally affected as BAQ increases but that recovery is slow and beyond the time limit tested in this experiment. A summary of the analysis of variance is presented in Table 11.

The correlation ratio between BAQ and performance for 18 male subjects was $r = 0.24$ and was significant at $p < 0.005$ level of risk. For 8 female social subjects, the correlation ratio was not statistically significant ($r = 0.020$).

A F test was made on male and female social drinkers to determine whether performance was more variable under elevated BAQ levels. All comparisons of variance on trials 1, 3, 4, and 7 were not significantly different from each other.

TABLE 9. SUMMARY OF ANALYSES FOR CREARE DEVICE.

Dependent Variable is the frequency in Hertz (Hz.). Data for 26 subjects tested are grouped as indicated.

8 Female Social Subjects Tested -
Correlation (Performance and BAQ) = 0.02

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.000	0.029	0.079	0.108	0.078	0.057	0.036
<u>Mean Hz.</u>	52.10	52.00	51.85	50.86	50.06	49.97	49.50
<u>Standard Deviation</u>	3.52	3.69	3.74	3.78	2.70	3.16	2.85
<u>Total Test Trials</u>	24	24	24	24	18	18	15

18 Male Social Subjects Tested -
Correlation (Performance and BAQ) = 0.24*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.000	0.034	0.087	0.101	0.080	0.057	0.043
<u>Mean Hz.</u>	52.78	52.93	51.80	51.44	51.56	52.29	52.33
<u>Standard Deviation</u>	3.35	3.32	3.11	3.52	3.46	3.38	3.53
<u>Total Test Trials</u>	54	54	54	54	48	45	48

* $p < 0.005$.

CREARE
18 MALE SOCIAL SUBJECTS

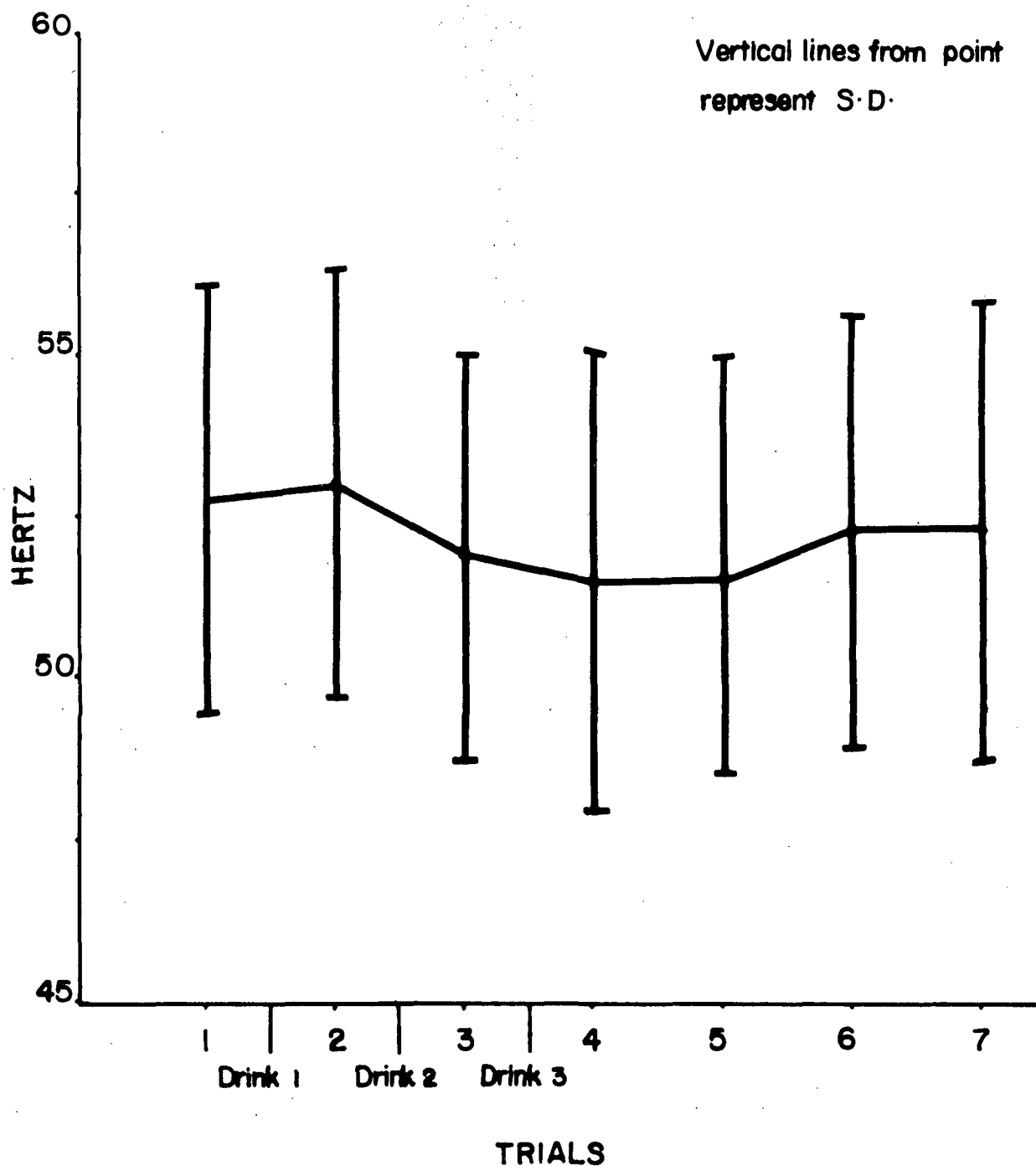


Figure 1. Relation between performance and test trials on the Creare device for 18 male social subjects.

CREARE

8 FEMALE SOCIAL SUBJECTS

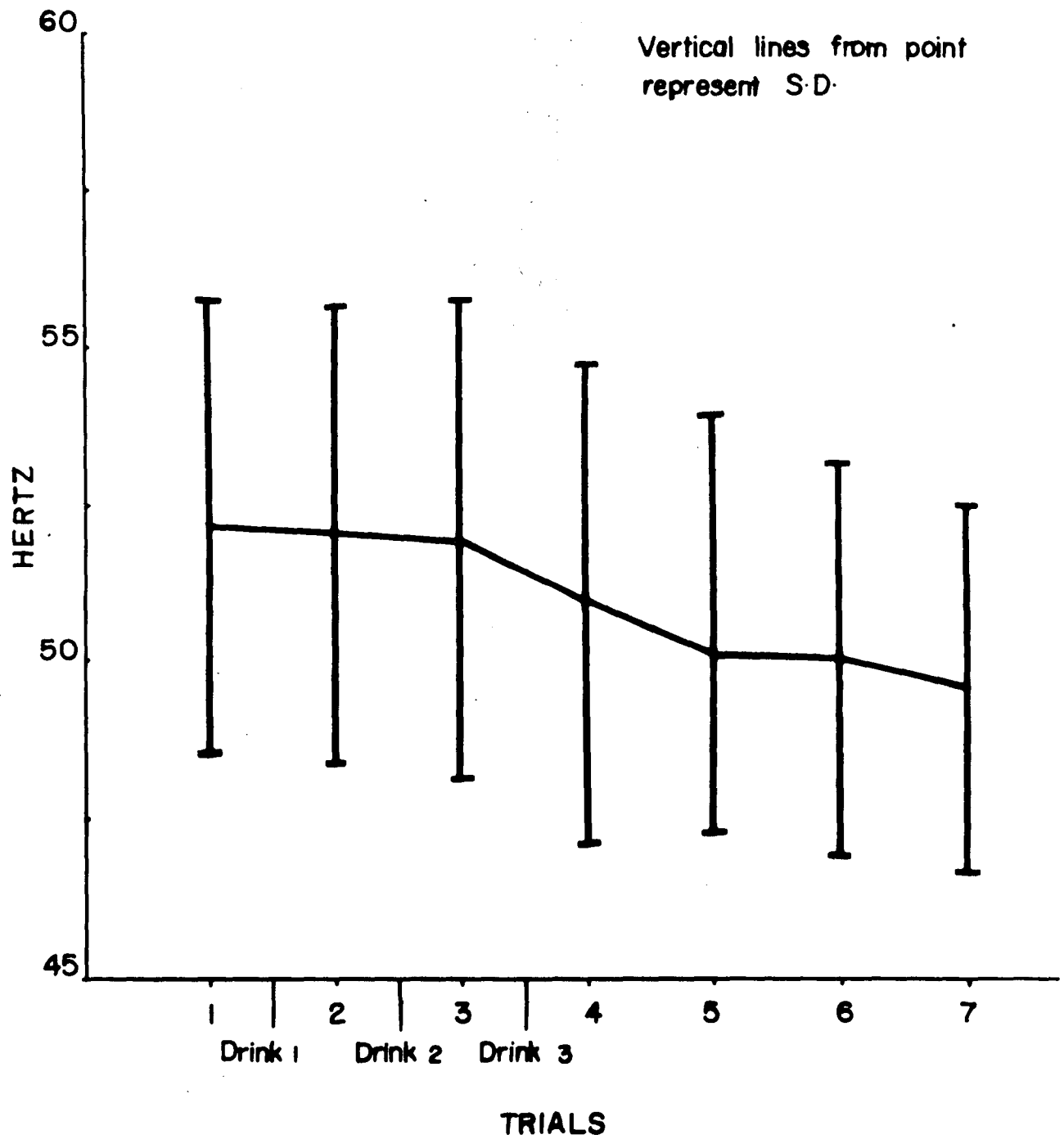


Figure 2. Relation between performance and test trials on the Creare device for 8 female social subjects.

TABLE 10. SUMMARY OF ANALYSIS OF VARIANCE FOR 18 MALE SOCIAL DRINKERS ON THE CREARE DEVICE.

<u>Sources of Variance</u>	<u>degrees of freedom</u>	<u>Sums of Squares</u>	<u>Mean Squares</u>	<u>F ratio</u>
Total	377	409,952.0	1,087.41	
Repetition (R)	2	80.0	40.0	
Trials (T)	6	10,720.0	1,786.67	5.39*
Subjects (S)	17	355,424.0	20,907.29	
R x T	12	448.0	37.33	
R x S	34	1,088.0	32.02	
T x S	102	33,792.0	333.29	
R x T x S	204	8,400.0	41.18	

*p < 0.005.

Error term for R is R x S.

Error term for T is T x S.

TABLE 11. SUMMARY OF ANALYSIS OF VARIANCE FOR 8 FEMALE SOCIAL DRINKERS ON THE CREARE DEVICE.

<u>Sources of Variance</u>	<u>degrees of freedom</u>	<u>Sums of Squares</u>	<u>Mean Squares</u>	<u>F ratio</u>
Total	167	179,352.0	1,073.96	
Repetition (R)	2	152.0	76.0	
Trials (T)	6	13,952.0	2,352.33	35.59*
Subjects (S)	7	165,112.0	23,587.43	
R x T	12	464.0	38.67	
R x S	14	816.0	58.29	
T x S	42	2,776.0	66.10	
R x T x S	84	1,632.0	19.43	

*p < 0.01.

Discussion of Results for the Creare Device

1. Performance by 18 male social drinkers shows a decrease in Critical Flicker Fusion (CFF) acuity as BAQ levels increase followed by a recovery of acuity as BAQ is reduced. The Tukey W-S-D test after analysis of variance shows that at the lower levels of alcohol (Trials 1, 2, 6 and 7), CFF acuity is greater than at the higher BAQ levels (Trials 3, 4, and 5).

2. Performance by 8 female social subjects continues to fall throughout the test trials. This indicates a less acute CFF as BAQ increases, but with no recovery of CFF acuity as BAQ is reduced. This may be interpreted that as alcohol levels increase, recovery of CFF acuity is slower than in males. However, with relatively few subjects tested, more data are needed before a more reliable interpretation is made.

3. No conclusions can be reached on either male or female registry subjects, or male and female control subjects because of the small number of subjects tested.

4. There was no difference in variability of responding under either elevated or reduced BAQ levels for male and female social drinkers

4.2.2 Drunken Driver Eliminator Device (DDE)

For this task, subjects had to press a foot pedal after a visual stimulus was presented. The dependent variable was the reaction time in milliseconds. The following subjects were tested:

- 18 male social
- 6 female social
- 5 male control
- 1 female control
- 1 female registry.

Subjects received 15 repetitions at each of the 7 test trials. Variability both between and within subjects was extremely large. In fact, the variability was so large that it was decided not to do any F tests because any significant findings would be virtually impossible to interpret. The total sum of squares was almost 385 million, a number that was enormous relative to the total number of subjects tested and the number of trials for each subject. A summary of the analysis of variance for male social and female social subjects is given in the Appendix A,

Tables III and IV. A summary of the mean data for these subjects as well as for the 5 male control subjects is presented in Table 12 and illustrated in Figs. 3, 4, and 5. As is evident from these figures, the shape of the functions as well as the large variability show tremendous fluctuation. This also occurred in the control subjects tested (Fig. 5, and Appendix A, Table V).

Mean scores on each of the 7 test trials were the only statistic obtained for the 1 female control and 1 registry female subjects tested. As in other groups, these scores also showed wide variability. Because of the number of subjects tested, no further analysis were done.

Pearson-Product correlations were obtained between BAQ and performance for male and female social subjects. Neither statistic was significant at the 0.05 level of risk. The calculated correlations were 0.03 for the 6 female social drinkers and 0.04 for the 18 male social drinkers.

Discussion of Results for the Drunken Driver Eliminator Device

For all groups tested, it was found that variability both within and between subjects was much too large for any reasonable conclusions to be reached. Because of the poor performance of this device it was dropped from further study.

4.2.3 A. S. Dwan Device

For this task, subjects were required to perform a complex manual dexterity task within a 15 second period. The dependent variable was the time in seconds that the subjects took to perform the correct response. If the subject could not perform the correct response within the allotted time, a score of 15 was given. The following subjects were tested on this device:

- 18 male social
- 6 female social
- 5 male control
- 1 female control
- 1 female registry

A summary of the analyses for the 18 male social and 6 female social subjects is given in Table 13 and illustrated in Figures 6 and 7.

Figure 6 shows that performance in social female subjects

TABLE 12. SUMMARY OF ANALYSES FOR DDE DEVICE.

Dependent variable is reaction time in milliseconds. Data for 29 subjects tested are grouped as indicated.

6 Female Social Subjects Tested - Correlation (Performance and BAQ) = 0.03

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.002	0.032	0.087	0.113	0.082	0.06	0.04
<u>Mean Re- action Time</u>	141.53	94.27	124.05	152.35	127.31	136.05	140.16
<u>Standard Deviation</u>	1136.10	163.90	223.07	224.35	192.06	1866.36	193.10
<u>Total Test Trials</u>	81	71	76	74	64	77	77

18 Male Social Subjects - Correlation (Performance and BAQ) = 0.04

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.000	0.032	0.089	0.106	0.078	0.056	0.041
<u>Mean Re- action Time</u>	152.74	281.56	170.74	172.34	252.68	215.80	195.72
<u>Standard Deviation</u>	430.13	705.04	230.48	221.19	540.34	548.62	397.09
<u>Total Test Trials</u>	274	240	247	242	259	249	242

5 Male Control Subjects

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>Mean Re- action Time</u>	125.16	252.53	120.54	85.41	129.05	147.09	175.39
<u>Standard Deviation</u>	359.21	321.00	1374.76	1457.36	195.40	233.08	279.45
<u>Total Test Trials</u>	55	51	57	51	56	56	56

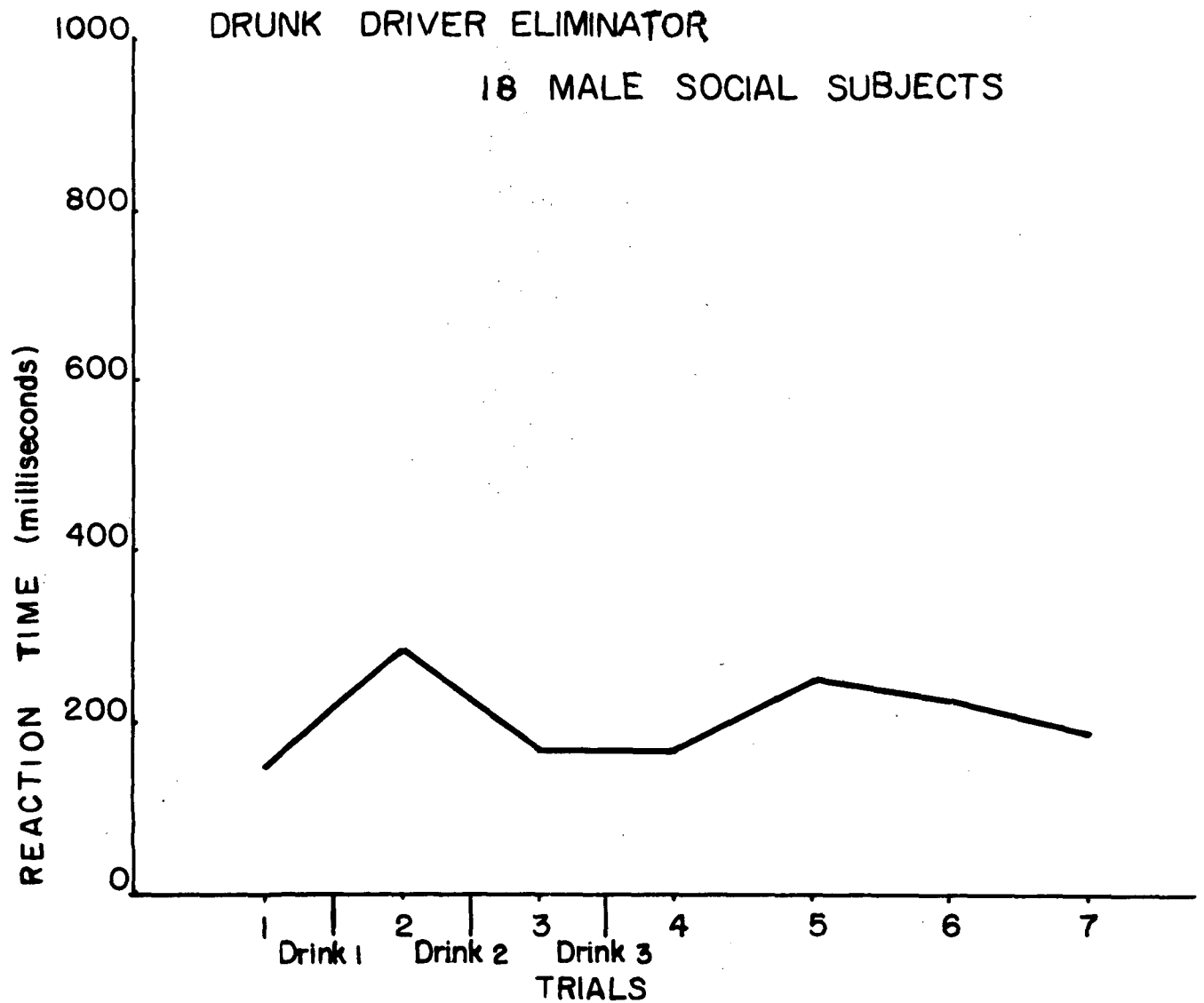


Figure 3. Relation between performance and test trials on the DDE device for 18 male social subjects.

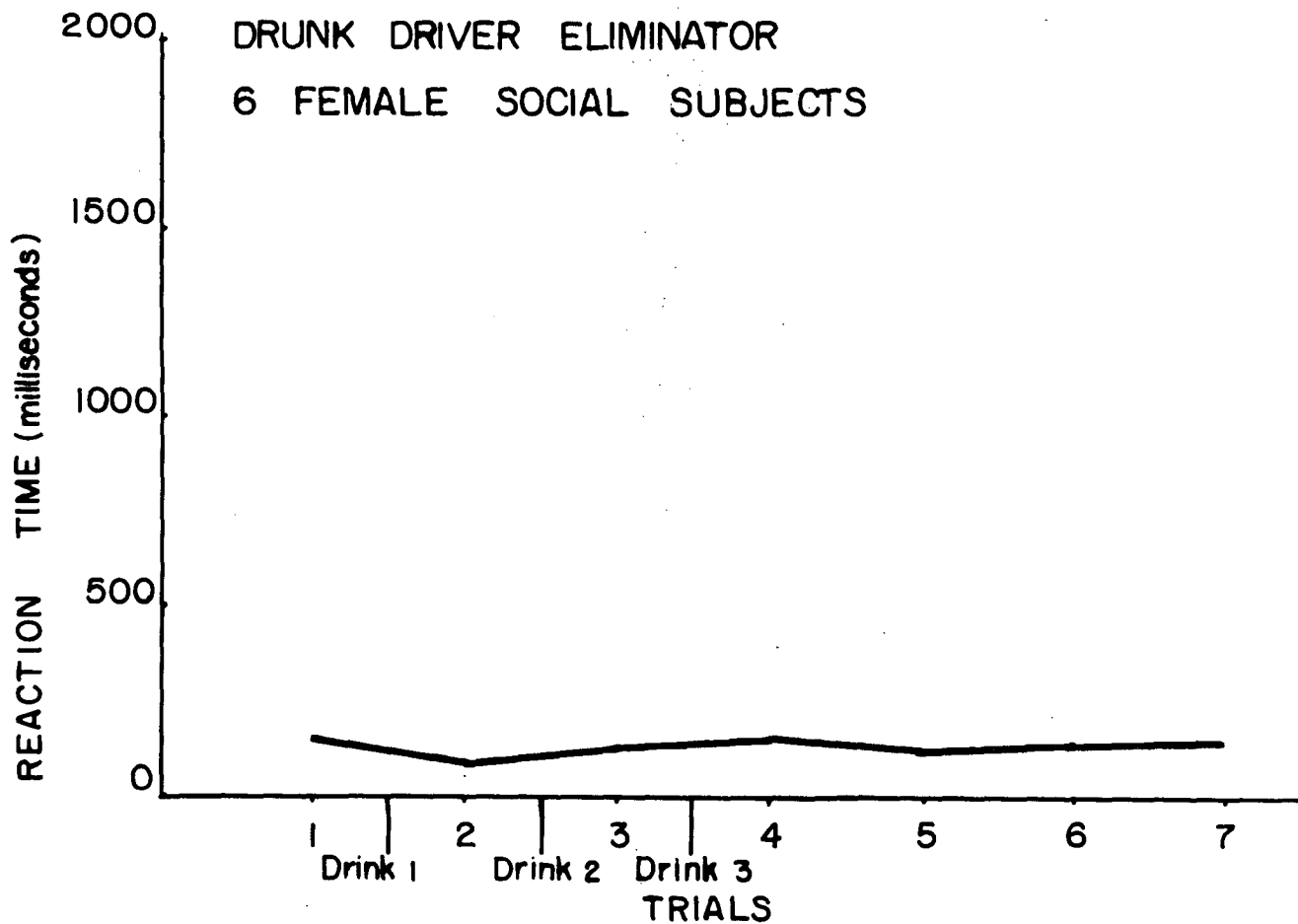


Figure 4. Relation between performance and test trials on the DDE device for 6 female social subjects.

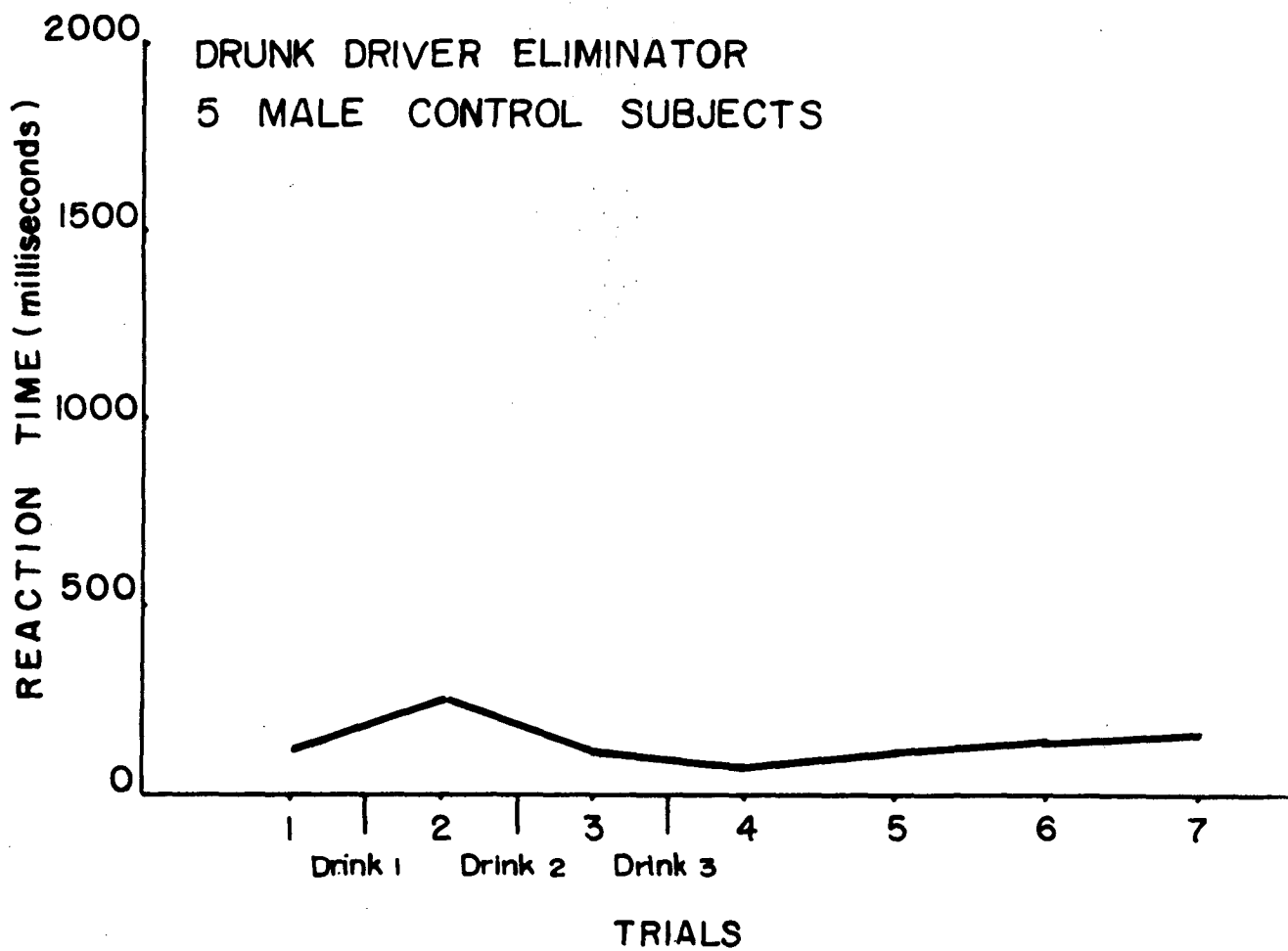


Figure 5. Relation between performance and test trials on the DDE device for 5 male control subjects.

TABLE 13. SUMMARY OF ANALYSES FOR A. S. DWAN DEVICE.

Dependent variable is time in seconds. Data for 24 subjects tested are grouped as indicated.

6 Female Social Subjects - Correlation (Performance and BAQ) = 0.06

<u>Trials</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.002	0.032	0.087	0.112	0.068	0.062	0.040
<u>Mean Time</u>	50.50	115.33	76.67	53.00	40.96	40.17	39.83
<u>Standard Deviation</u>	32.65	228.96	108.87	30.61	21.90	15.73	24.76
<u>Total Test Trials</u>	30	30	30	30	25	30	30

18 Male Social Subjects - Correlation (Performance and BAQ) = 0.159*

<u>Trials</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.00	0.033	0.090	0.107	0.080	0.059	0.044
<u>Mean Time</u>	38.88	38.77	53.65	47.18	42.47	46.65	36.88
<u>Standard Deviation</u>	17.73	19.92	32.29	29.64	21.04	23.83	17.04
<u>Total Test Trials</u>	85	85	85	85	85	85	85

5 Male Control Subjects

<u>Trials</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>Mean Time</u>	4.44	3.34	3.88	3.30	5.54	4.32	2.27
<u>Standard Deviation</u>	3.35	1.53	2.22	0.98	5.05	4.18	1.03
<u>Total Test Trials</u>	25	25	25	25	25	25	24

* $p < 0.01$.

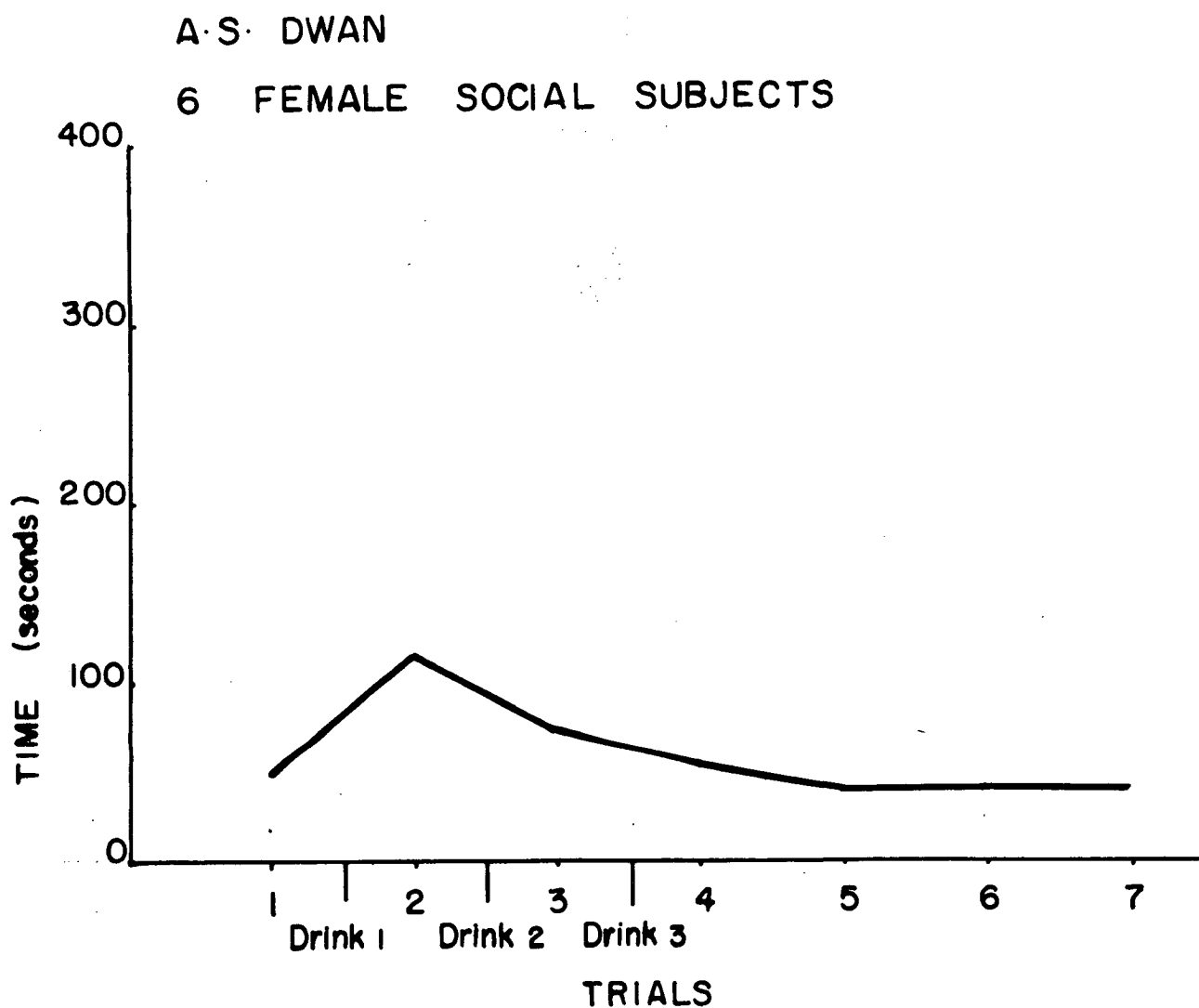


Figure 6. Relation between performance and test trials on the A. S. Dwan device for 6 female social subjects.

A.S. DWAN

18 MALE SOCIAL SUBJECTS

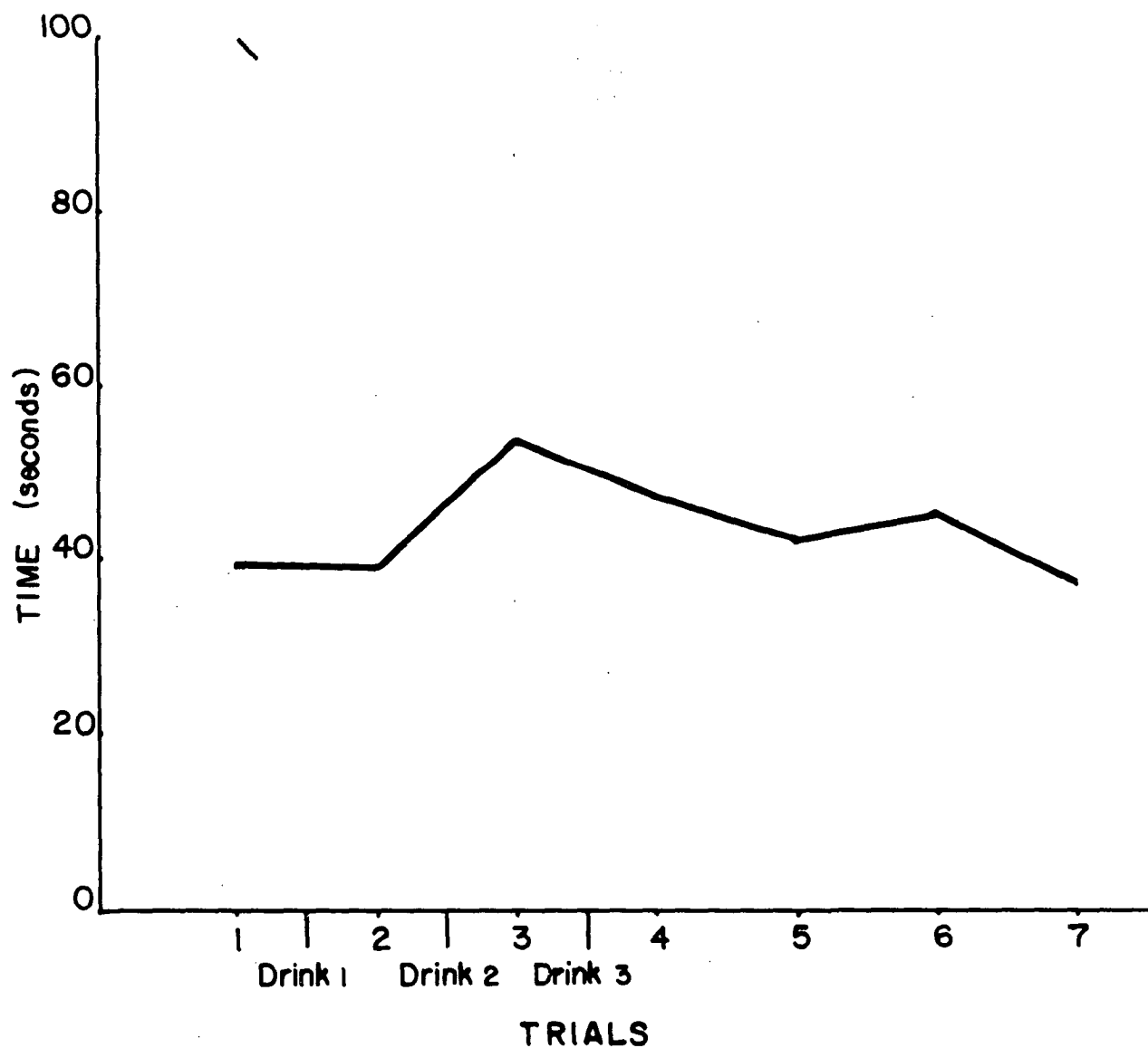


Figure 7. Relation between performance and test trials on the A. S. Dwan device for 18 male social subjects.

was most affected after the first drink. If more female social subjects had been tested, different findings might have resulted. Figure 7 shows that performance in social male subjects was most detrimentally effected after the second drink (Trial 3) but then continued to improve throughout the remainder of the test session. The exception found at Trial 6 was not significant. Summary for male social subjects of the analysis of variance results showed that both trial means and repetitions within each trial were statistically significant ($p < 0.01$ and $p < 0.05$ respectively). A summary of this analysis of variance is reported in Table. 14

TABLE 14. SUMMARY OF ANALYSIS OF VARIANCE FOR 18 MALE SOCIAL DRINKERS ON THE A. S. DWAN DEVICE.

<u>Sources of Variance</u>	<u>degrees of freedom</u>	<u>Sums of Squares</u>	<u>Mean Squares</u>	<u>F ratio</u>
Total	594	348,186.25	586.17	
Repetitions (R)	4	4,939.25	1,234.81	2.62*
Trials (7)	6	17,810.50	2,968.42	4.76**
Subjects (S)	16	49,699.50	3,106.20	
R x T	24	15,119.50	629.98	
R x S	64	30,144.00	471.00	
T x S	96	59,833.25	623.26	
R x T x S	384	170,640.50	444.38	

* $p < 0.05$.

** $p < 0.01$.

A Tukey W-S-D test after analysis of variance showed that although the mean of Trial 3 reflected the slowest performance by the subjects, it did not differ significantly from the means of Trials 4 or 6. The mean performance level obtained on Trial 4 differed only from one mean obtained on the last test trial, Trial 7.

An analysis of variance on the 6 social female subjects did not show any significant results and a summary of the analysis is presented in Appendix A, Table VI.

Figure 8 shows the relation between performance on A. S. Dwan device for 5 male control subjects on the 7 test trials. There appears to be random variability throughout the experimental test sessions, but because of the relatively small number of subjects tested, any further interpretation of the data would be too speculative.

The one registry female subject tested had high mean scores relative to other subjects. However, because only 1 subject was involved no interpretation can be made on the data. This subject's mean scores are given in Table VII in the Appendix A.

A Product-moment correlation was computed for the 18 male social, and 6 female social subjects relating performance to BAQ. The correlation for the 6 female social drinkers was 0.059 and was not statistically significant. The correlation for male social drinkers was 0.159 and was significant at $p < 0.01$ level of risk.

A F test was done to determine if variability in responding was greater under elevated BAQ levels than under reduced or zero alcohol levels. In this test a ratio is made of the two variances to be compared with the larger variance being in the numerator. The resultant F ratio (which naturally is greater than 1.00) is compared to the F distribution corresponding to the appropriate degrees of freedom for the numerator and denominator. If a significant F ratio were to occur for the α level chosen, it would indicate that the two variances for the trials chosen represent variances from different populations. Throughout this study the variances on Trials 1, 3, 4, and 7 were compared with each other. The rationale for this procedure was that while Trial 1 represents a control condition, Trial 7 represents a BAQ that has just been reduced to approximately 0.05%--a BAQ level that is considered safe for driving. On the other hand, Trial 3 represents a level of approximately 0.10% and increasing while Trial 4 is the trial with the highest mean BAQ.

The results of this test are presented in Table 15. For the 18 male social subjects, there was a considerable increase in variability in responding under Trials 3 and 4 than under Trials 1 and 7. The 6 female social subjects showed an increase in variability under Trial 3 over both the control (Trial 1) and Trial 7 conditions. However the 5 male control subjects showed large random variability throughout the test session. These results suggest that although variability in responding may increase (as expected) with an increased BAQ level, a large, randomly distributed variability may be characteristic to the design of the device.

A. S. DWAN

Vertical lines from point
represent S.D.

5 MALE CONTROL SUBJECTS

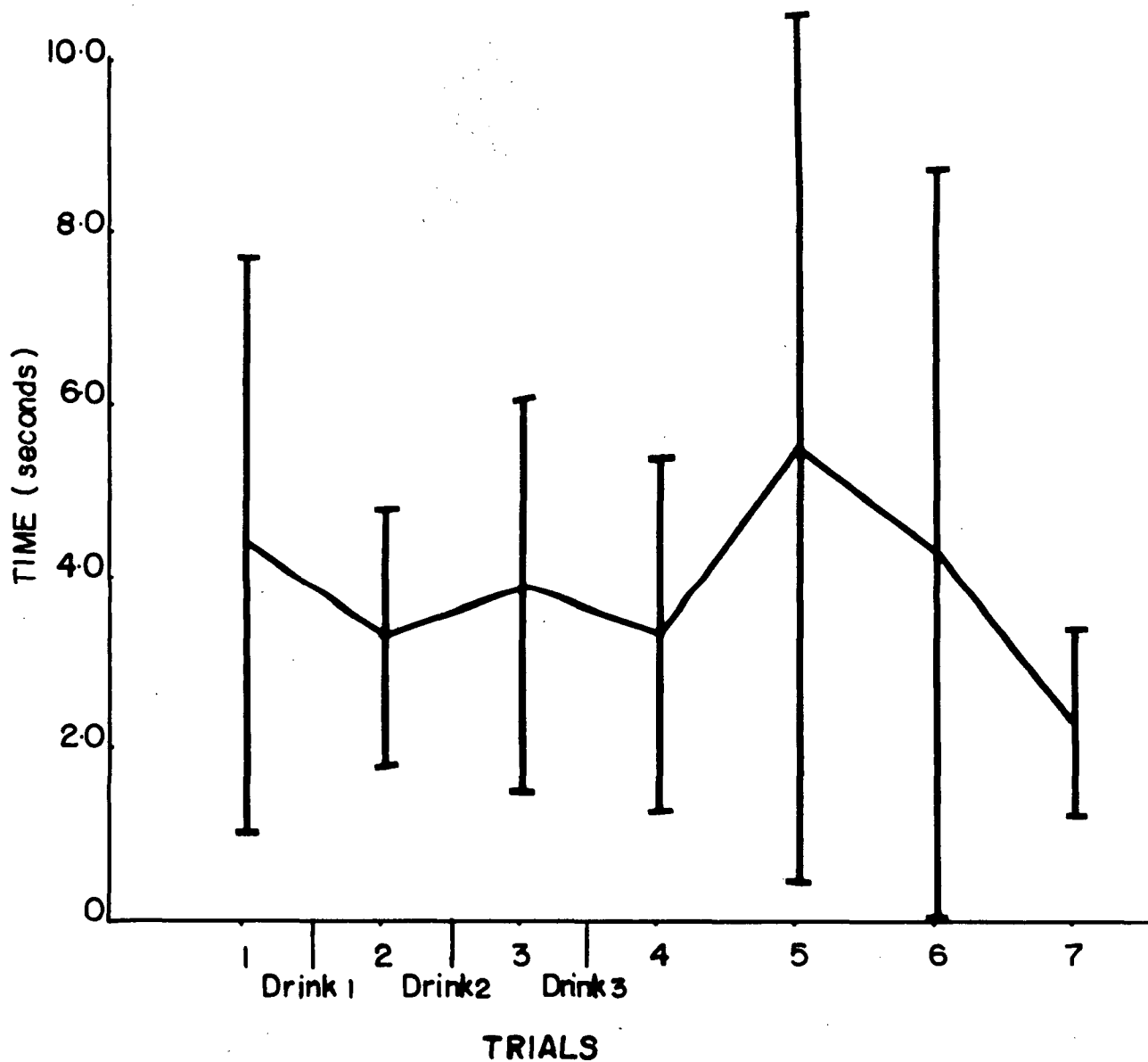


Figure 8. Relation between performance and test trials on the A. S. Dwan device for 5 male control subjects.

TABLE 15. SUMMARY OF F TESTS FOR DIFFERENCES IN VARIANCE BETWEEN INDICATED TRIALS AND GROUPS ON THE A. S. DWAN DEVICE.

(T = Trial)

<u>18 Male Social Subjects</u>	<u>6 Female Social Subjects</u>	<u>5 Male Control Subjects</u>
$T_3 : T_1 = 3.31^{**}$	$T_3 : T_1 = 11.12^{**}$	$T_1 : T_3 = 2.27^*$
$T_4 : T_1 = 2.79^{**}$	$T_1 : T_4 = 1.14$	$T_1 : T_4 = 11.70^{**}$
$T_3 : T_7 = 3.59^{**}$	$T_3 : T_7 = 19.34^{**}$	$T_3 : T_7 = 4.64^{**}$
$T_4 : T_7 = 3.02^{**}$	$T_4 : T_7 = 1.53$	$T_7 : T_4 = 1.11$
$T_1 : T_7 = 1.08$	$T_1 : T_7 = 1.74$	$T_1 : T_7 = 10.53^{**}$

* $p < 0.05$.

** $p < 0.01$.

Discussion of Results for the A. S. Dwan Device

1. Social male drinkers perform worse under elevated alcohol conditions and better when they have either minimum or reduced alcohol levels ($p < 0.01$).

2. However, even though there was a significant correlation between BAQ and performance ($r = 0.159$) only a small amount of variability in performance could be accounted ($r = 2.5\%$, coefficient of determination). The remaining 97.5% of the variability is unaccountable in terms of the variables studied.

3. Social female drinkers and male control subjects did not show a statistical significant correlation between BAQ and performance.

4. Since only 1 registry subject was tested, no conclusions could be reached on this group of subjects.

5. For male and female social drinkers, variability is greater under elevated BAQ levels than under reduced or zero BAQ levels. However, with the control group showing random variability throughout the test session, a large, randomly distributed variability may be characteristic to the design of the device.

4.2.4 Pursuit Tracking Device

This was a divided attention pursuit tracking task in which two different responses were required by each subject. First, the subject tracked a moving target in a typical pursuit tracking situation. The dependent variable was the integrated absolute position difference between the target and indicator that was controlled by the subject. Thus, a subject who was always on target could theoretically get a score of zero, and a higher score indicated a poorer performance. While performing the tracking task the subject was required to monitor two different pictures on a separate display and to press a button for one picture and a different button for the other picture. Here, the dependent variable was the percent of correct response to the visual stimulus.

The following subjects were tested on this device:

- 9 male registry
- 3 female registry
- 17 male social
- 3 female social

In order to increase the sample size, both social groups as well as both registry groups were combined, giving a sample size of 20 social and 12 registry subjects and data analysis was done on both of these groups.

Table 16 summarizes the analyses for both groups on the tracking response while Fig. 9 shows the distribution between trials and performance for the 20 social subjects and 12 registry subjects on the tracking measure. As is obvious from the graph, performance is: (1) adversely affected under elevated BAQ levels for both groups and (2) the registry subjects did significantly poorer than the social subjects under all test conditions. Analysis of variance for each group showed a significant difference in mean performance over trials. These results are summarized in Tables 17 and 18. A Tukey W-S-D test showed in each group that performance under Trial 4 was significantly poorer than on all other trials. No other significant mean differences within each group were found.

A correlation coefficient between BAQ and tracking performance showed an $r = 0.23$ for the social subjects and an $r = 0.39$ for the registry subjects. Both coefficients were significant at $p \leq 0.005$.

TABLE 16. SUMMARY OF ANALYSES FOR PURSUIT TRACKING DEVICE.

Dependent variable is error in accumulated voltage. The 32 subjects tested are grouped as indicated.

12 Registry Subjects - Correlation (Performance and BAQ) = 0.392*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.008	0.039	0.081	0.143	0.109	0.086	0.065
<u>Mean Error</u>	279.03	268.85	287.60	427.77	338.23	293.97	272.03
<u>Standard Deviation</u>	88.82	82.80	92.41	157.94	104.93	81.76	74.17
<u>Total Test Trials</u>	60	60	60	60	60	60	60

20 Social Subjects - Correlation (Performance and BAQ) = 0.232*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.001	0.035	0.082	0.105	0.081	0.062	0.044
<u>Mean Error</u>	211.11	203.89	224.21	281.73	227.03	219.08	200.92
<u>Standard Deviation</u>	43.88	61.08	71.36	124.38	67.92	65.90	62.75
<u>Total Test Trials</u>	100	100	100	100	100	100	100

* $p < 0.05$.

PURSUIT TRACKING
20 SOCIAL AND 12 REGISTRY SUBJECTS
TRACKING RESPONSE

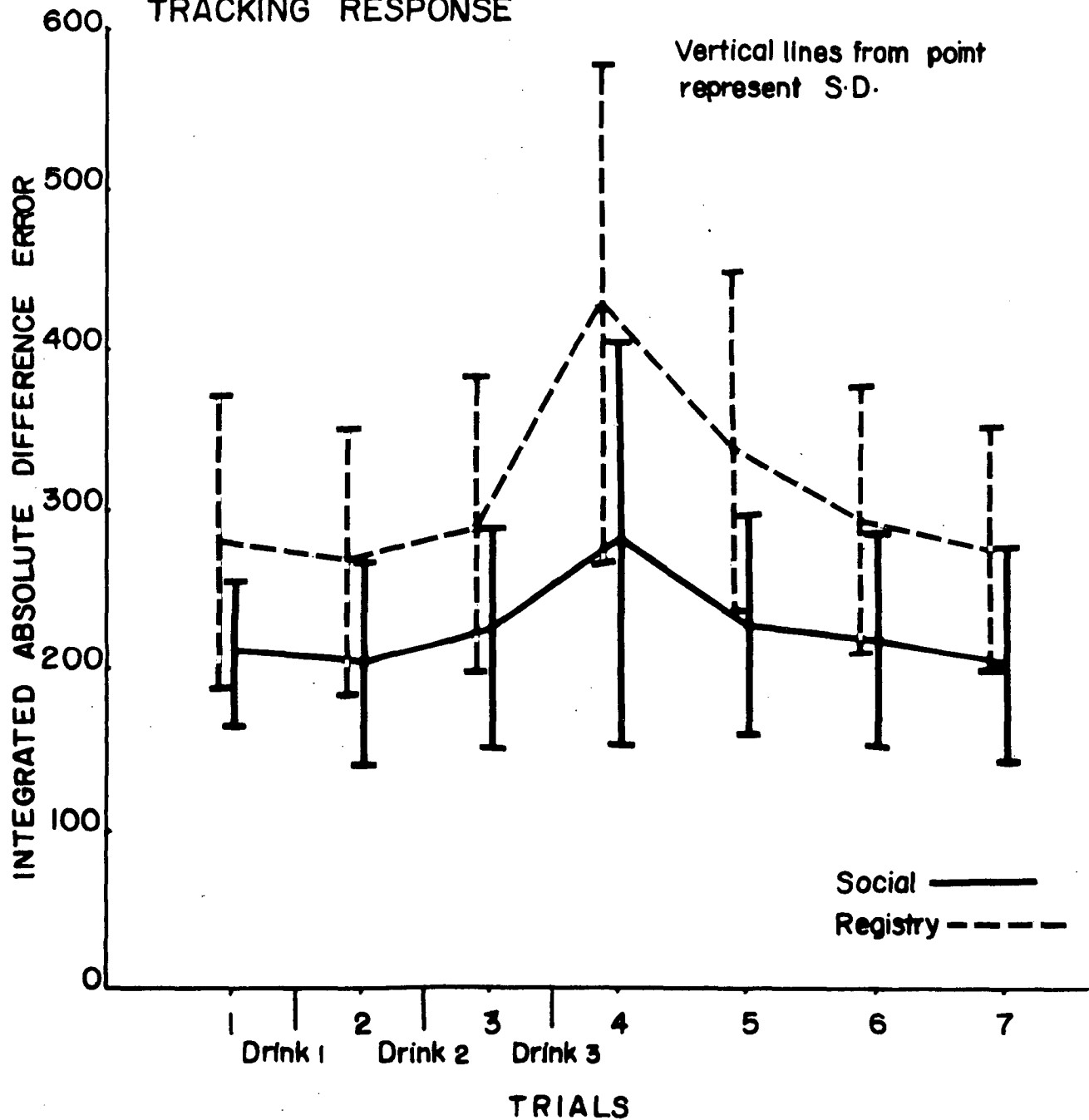


Figure 9. Relation between performance and test trials on the Pursuit Tracking device for 20 social and 12 registry subjects. (Curves displaced for clarity.)

TABLE 17. SUMMARY OF ANALYSIS OF VARIANCE FOR 20 SOCIAL SUBJECTS TESTED ON THE TRACKING RESPONSE OF THE PURSUIT TRACKING DEVICE.

<u>Sources of Variance</u>	<u>degrees of freedom</u>	<u>Sum of Squares</u>	<u>Mean Squares</u>	<u>F ratio</u>
Total	699	4,212,416.0	6,026.35	
Repetitions (R)	4	27,872.0	6,968.00	4.46*
Trials (T)	6	439,632.0	73,271.98	11.33**
Subjects (S)	19	2,344,264.0	123,382.30	
R x T	24	29,952.0	1,248.00	
R x S	76	118,792.0	1,563.05	
T x S	114	737,320.0	6,467.72	
R x T x S	456	514,584.0	1,128.47	

* $p < 0.01$.

** $p < 0.001$.

TABLE 18. SUMMARY OF ANALYSIS OF VARIANCE FOR 12 REGISTRY SUBJECTS TESTED ON THE TRACKING RESPONSE OF THE PURSUIT TRACKING DEVICE.

<u>Sources of Variance</u>	<u>degrees of freedom</u>	<u>Sum of Squares</u>	<u>Mean Squares</u>	<u>F ratio</u>
Total	419	5,384,736.0	12,851.40	
Repetitions (R)	4	12,664.0	3,166.00	
Trials (T)	6	1,171,048.0	195,174.62	16.51*
Subjects (S)	11	2,105,160.0	191,378.12	
R x T	24	64,280.0	2,678.33	
R x S	44	204,744.0	4,653.27	
T x S	66	780,352.0	11,823.51	
R x T x S	264	1,046,488.0	3,963.97	

* $p < 0.001$.

A summary of the analyses of the percent correct responses to the secondary task stimulus made by subjects while performing the tracking task on the Pursuit Tracking device is given in Table 19 and illustrated in Figure 10. Again the 20 social subjects scored higher than the 12 registry subjects on all trials tested. Analysis of variance on this data showed a significant mean difference over trials for each group. This is summarized in Tables 20 and 21.

TABLE 19. SUMMARY OF ANALYSES FOR PURSUIT TRACKING DEVICE.

Dependent variable is percent correct response to extraneous stimulus. The 32 subjects tested are grouped as indicated.

12 Registry Subjects

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.008	0.039	0.081	0.143	0.109	0.086	0.065
<u>Mean per-</u> <u>cent Correct</u>	92.75	91.99	90.62	76.13	87.40	91.62	92.94
<u>Standard</u> <u>Deviation</u>	8.06	7.49	6.58	17.07	10.02	6.33	4.82
<u>Total</u> <u>Test Trials</u>	12	12	12	12	12	12	12

20 Social Subjects

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.001	0.035	0.082	0.105	0.081	0.062	0.044
<u>Mean per-</u> <u>cent Correct</u>	95.30	94.88	91.14	87.86	90.10	92.11	94.94
<u>Standard</u> <u>Deviation</u>	4.17	5.63	7.74	10.71	7.18	4.84	4.17
<u>Total</u> <u>Test Trials</u>	20	20	20	20	20	20	20

PURSUIT TRACKING

20 SOCIAL AND 12 REGISTRY SUBJECTS

PERCENT CHANGE

Vertical lines from point
represent S.D.

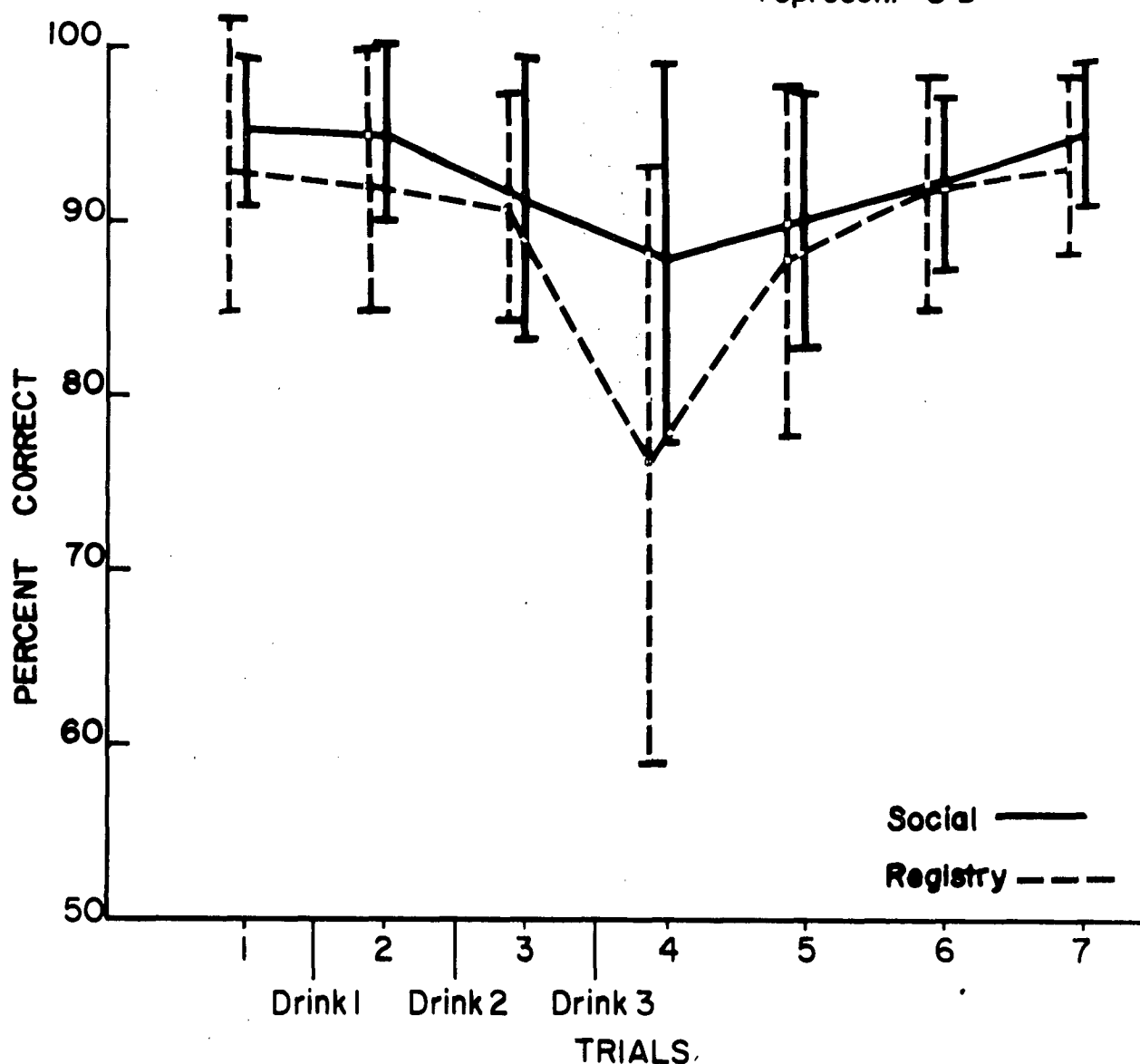


Figure 10. Relation between percent correct responses and test trials on the Pursuit Tracking device for 20 social and 12 registry subjects. (Curves displaced for clarity.)

TABLE 20. SUMMARY OF ANALYSIS OF VARIANCE ON THE PERCENT CORRECT RESPONSE FOR 20 SOCIAL SUBJECTS TESTED ON THE PURSUIT TRACKING DEVICE.

<u>Sources of Variance</u>	<u>degrees of freedom</u>	<u>Sums of Squares</u>	<u>Mean Squares</u>	<u>F ratio</u>
Total	139	697,232.0	5,016.06	
Trials (T)	6	96,976.0	16,162.66	6.55*
Subjects (S)	19	319,072.0	16,793.26	
T x S	114	281,184.0	2,466.52	

* $p < 0.01$.

TABLE 21. SUMMARY OF ANALYSIS OF VARIANCE ON THE PERCENT CORRECT RESPONSE FOR 12 REGISTRY SUBJECTS TESTED ON THE PURSUIT TRACKING DEVICE.

<u>Sources of Variance</u>	<u>degrees of freedom</u>	<u>Sums of Squares</u>	<u>Mean Squares</u>	<u>F ratio</u>
Total	83	940,584.0	11,332.34	
Trials (T)	6	259,312.0	43,218.66	9.28*
Subjects (S)	11	373,760.0	33,978.17	
T x S	66	307,504.0	4,659.15	

* $p < 0.01$.

A Tukey W-S-D test after anova again showed that performance by each group under Trial 4 was significantly poorer than under any other trial. No other significant means were demonstrated. Finally, a "F" test for significant variance showed that, in general, variability was significantly greater under increased BAQ levels. These results are summarized in Table 22.

Discussion of Results for the Pursuit Tracking Device

1. Twenty social and 12 registry subjects were tested with this device. Because of the small number of female subjects tested in each group, the sexes were combined to give a larger sample for each group.

TABLE 22. SUMMARY OF F TESTS FOR DIFFERENCES IN VARIANCE BETWEEN INDICATED TRIALS AND GROUPS ON THE PURSUIT TRACKING DEVICE.

(T = Trial)

Tracking		Percent Correct	
20 Social Subjects	12 Registry Subjects	20 Social Subjects	12 Registry Subjects
$T_3 : T_1 = 2.64^*$	$T_3 : T_1 = 1.08$	$T_3 : T_1 = 3.44^{**}$	$T_1 : T_3 = 1.50$
$T_4 : T_1 = 8.03^{**}$	$T_4 : T_1 = 3.16^*$	$T_4 : T_1 = 6.59^{**}$	$T_4 : T_1 = 4.49^{**}$
$T_4 : T_7 = 3.93^{**}$	$T_4 : T_7 = 5.44^{**}$	$T_4 : T_7 = 6.61^{**}$	$T_4 : T_7 = 12.56^{**}$
$T_3 : T_7 = 1.29$	$T_3 : T_7 = 1.55$	$T_3 : T_7 = 3.45^{**}$	$T_3 : T_7 = 1.86$
$T_7 : T_1 = 2.04$	$T_1 : T_7 = 1.43$	$T_1 : T_7 = 1.00$	$T_1 : T_7 = 2.80$

* $p < 0.05$.

** $p < 0.01$.

2. Two dependent measures were recorded: (1) a tracking response measured as a deviation in voltage between the target and indicator that was being manipulated by the subject and, (2) the total percentage of time subject made a correct response to a secondary task stimulus that was presented while tracking.

3. Under elevated BAQ levels subjects in both groups tracked more poorly ($p < 0.01$) and made more errors ($p < 0.01$) to the extraneous stimulus than under reduced or zero levels.

4. On both measures studied, the social subjects performed consistently better than the registry subjects.

5. On the tracking task, both groups showed a significant correlation between BAQ and performance.

6. In general, variance in responding was greater for subjects with elevated BAQ levels than for reduced levels.

4.2.5 Compensatory Tracking Device

As in Pursuit Tracking, the dependent variable on this typical compensatory tracking instrument was the integrated absolute position difference between the moving target and a zero point. The same 32 subjects were tested on this device as on the Pursuit Tracker and as expected, results

were very similar. The following subjects were tested on this device:

- 9 male registry
- 3 female registry
- 17 male social
- 3 female social

Date for these subjects are summarized in Table 23 and illustrated in Figure 11. As is evident from the graph, performance was adversely effected on Trial 4 for both groups--the trial with the highest mean BAQ. Notice the similarity in performance by the 12 registry and 20 social subjects on this device and the Pursuit Tracking task. An analysis of variance showed that for each group, there was a significant difference in means across trials. A summary of the analysis of variance is presented in Tables 24 and 25.

These graphs also show that the 20 social subjects performed consistently better than the 12 registry subjects. However the difference was not statistically significant. Results of the Tukey W-S-D test of significance after analysis of variance showed that for each group, the mean on Trial 4 was the only mean that was significantly different from all other means. For the 12 registry subjects the Repetitions main effect was significant, $p < 0.01$ (Table 25). Tukey analysis of the five repetitions within each test trial showed that performance continued to improve within each session. These subjects gave a very poor initial response and continued to improve over the next 4 repetitions.

Correlation coefficients, relating BAQ to performance were computed for each group. Each was found to be significant at $p < 0.001$ level of risk. The correlation coefficient for the 12 registry subjects was $r = 0.35$ while the correlation for the 20 social subjects was $r = 0.26$.

A comparison of the variance between elevated BAQ levels and reduced levels and control conditions also showed that in general, variability is greater under increased BAQ levels. Further, for the social drinkers, performance was significantly more variable under Trial 4 than under the control condition ($p < 0.05$). Results of these tests are presented in Table 26.

TABLE 23. SUMMARY OF ANALYSES FOR COMPENSATORY TRACKING DEVICE.

Dependent variable is error in accumulated voltage/sec. The 32 subjects tested are grouped as indicated.

12 Registry Subjects - Correlation (Performance and BAQ) = 0.351*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.008	0.039	0.081	0.143	0.109	0.086	0.065
<u>Mean Error</u>	282.12	274.78	287.78	343.43	319.80	301.88	289.85
<u>Standard Deviation</u>	48.24	36.71	45.14	82.81	69.49	52.68	50.33
<u>Total Test Trials</u>	60	60	60	60	60	60	60

20 Social Subjects - Correlation (Performance and BAQ) = 0.259*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.001	0.035	0.082	0.105	0.081	0.062	0.044
<u>Mean Error</u>	271.72	260.47	281.07	318.49	292.44	269.74	268.68
<u>Standard Deviation</u>	37.81	41.27	48.54	94.51	46.26	39.04	45.11
<u>Total Test Trials</u>	100	100	100	100	100	100	100

26 Male Subjects - Correlation (Performance and BAQ) = 0.355*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.015	0.035	0.079	0.101	0.091	0.120	0.050
<u>Mean Error</u>	275.43	262.89	280.36	324.54	302.76	280.64	275.69
<u>Standard Deviation</u>	40.88	36.93	44.81	78.90	55.95	45.70	45.70
<u>Total Test Trials</u>	130	130	130	130	130	130	130

TABLE 23--(Continued)

6 Female Subjects - Correlation (Performance and BAQ) = 0.241*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.019	0.039	0.082	0.124	0.094	0.067	0.050
<u>Mean Error</u>	276.92	278.50	297.44	355.20	307.50	286.23	280.44
<u>Standard Deviation</u>	47.91	50.49	53.89	117.76	65.22	53.35	56.71
<u>Total Test Trials</u>	30	30	30	30	30	30	30

9 Male Registry - Correlation (Performance and BAQ) = 0.388*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.011	0.040	0.082	0.144	0.110	0.176	0.062
<u>Mean Error</u>	288.96	280.33	294.19	356.78	331.69	310.76	301.20
<u>Standard Deviation</u>	47.55	30.28	43.77	84.01	69.55	45.81	44.91
<u>Total Test Trials</u>	45	45	45	45	45	45	45

3 Female Registry - Correlation (Performance and BAQ) = 0.245**

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.037	0.039	0.078	0.138	0.105	0.072	0.052
<u>Mean Error</u>	261.77	257.53	266.40	308.40	290.13	275.33	257.40
<u>Standard Deviation</u>	45.86	49.42	42.69	68.99	64.86	63.99	49.75
<u>Total Test Trials</u>	15	15	15	15	15	15	15

TABLE 23--(Continued)

17 Male Social - Correlation (Performance and BAQ) = 0.233*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.017	0.033	0.078	0.105	0.081	0.091	0.043
<u>Mean Error</u>	268.27	253.65	273.04	307.47	287.45	264.69	262.19
<u>Standard Deviation</u>	35.10	36.95	43.85	70.80	39.86	36.94	40.23
<u>Total Test Trials</u>	85	85	85	85	85	85	85

3 Female Social - Correlation (Performance and BAQ) = 0.408***

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.00	0.040	0.085	0.110	0.082	0.062	0.047
<u>Mean Error</u>	292.07	299.47	328.47	402.00	324.87	297.13	303.47
<u>Standard Deviation</u>	46.47	43.54	46.14	138.82	62.91	39.33	55.23
<u>Total Test Trials</u>	15	15	15	15	15	15	15

Total 32 Subjects - Correlation (Performance and BAQ) = 0.329*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.016	0.036	0.080	0.120	0.092	0.110	0.050
<u>Mean Error</u>	275.68	265.78	283.78	328.35	302.76	281.79	276.66
<u>Standard Deviation</u>	42.18	40.17	47.08	90.91	57.44	47.15	47.81
<u>Total Test Trials</u>	160	160	160	160	160	160	160

*p < 0.01.

**p < 0.02.

***p < 0.001.

COMPENSATORY TRACKING

20 SOCIAL AND 12 REGISTRY SUBJECTS

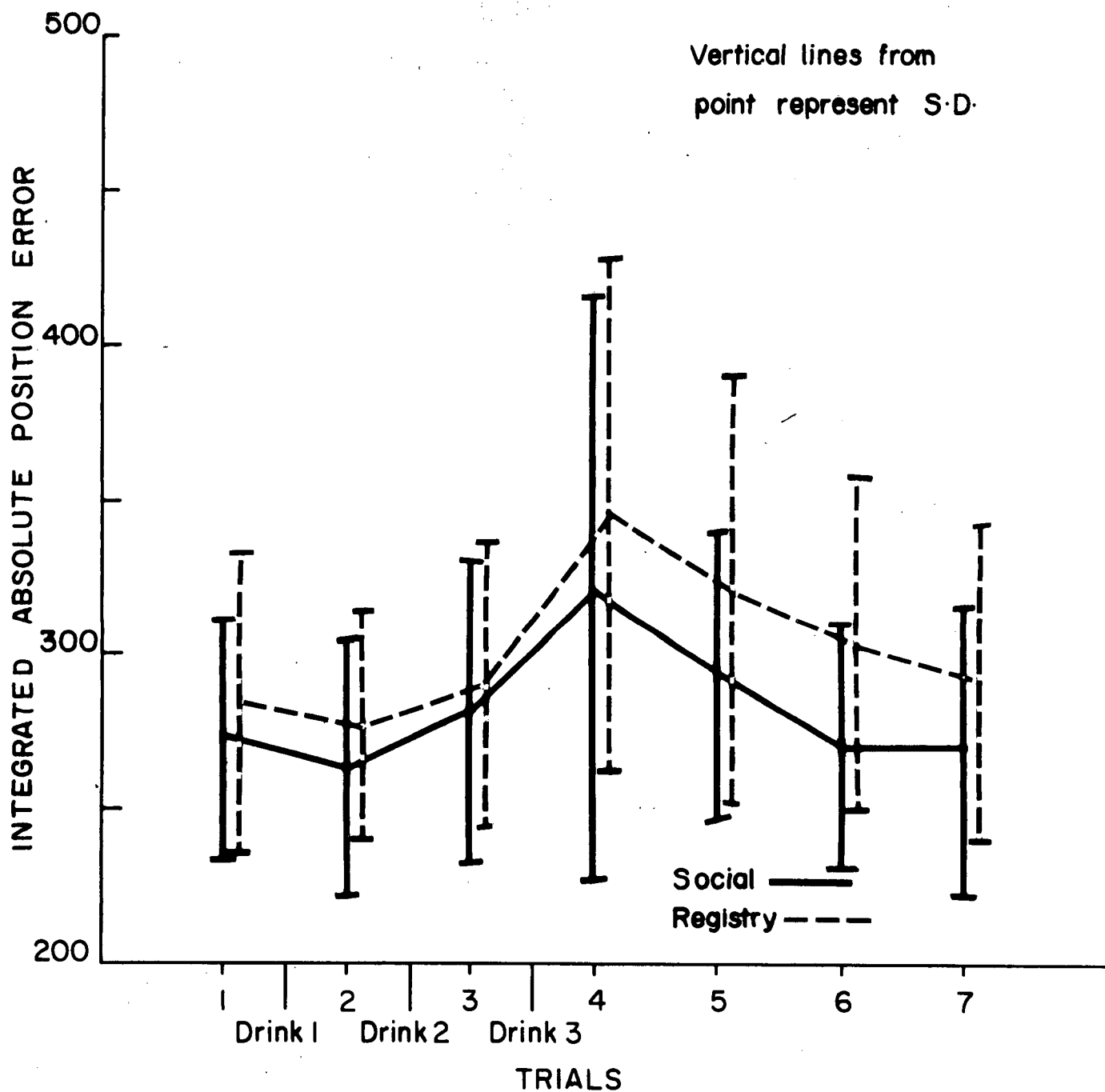


Figure 11. Relation between performance and test trials on the Compensatory Tracking device for 20 social and 12 registry subjects. (Curves displaced for clarity.)

TABLE 24. SUMMARY OF ANALYSIS OF VARIANCE FOR 20 SOCIAL SUBJECTS ON THE COMPENSATORY TRACKING DEVICE.

<u>Sources of Variance</u>	<u>degrees of freedom</u>	<u>Sum of Squares</u>	<u>Mean Squares</u>	<u>F ratio</u>
Total	699	2,223,272.0	3,180.65	
Repetitions (R)	4	2,768.0	692.00	
Trials (T)	6	231,968.0	38,661.33	9.14*
Subjects (S)	19	919,328.0	48,385.67	
R x T	24	42,824.0	1,784.33	
R x S	76	81,392.0	1,070.95	
T x S	114	482,280.0	4,230.52	
R x T x S	456	462,712.0	1,014.72	

* $p < 0.01$.

TABLE 25. SUMMARY OF ANALYSIS OF VARIANCE FOR 12 REGISTRY SUBJECTS ON THE COMPENSATORY TRACKING DEVICE.

<u>Sources of Variance</u>	<u>degrees of freedom</u>	<u>Sums of Squares</u>	<u>Mean Squares</u>	<u>F ratio</u>
Total	419	1,548,848.0	3,696.53	
Repetitions (R)	4	18,160.0	454.00	4.22*
Trials (T)	6	209,392.0	34,898.66	8.84*
Subjects (S)	11	690,104.0	62,736.72	
R x T	24	34,664.0	1,444.33	
R x S	44	47,280.0	1,074.54	
T x S	66	260,520.0	3,947.27	
R x T x S	264	288,728.0	1,093.67	

* $p < 0.01$.

TABLE 26. SUMMARY OF F TESTS FOR DIFFERENCES IN VARIANCE BETWEEN INDICATED TRIALS AND GROUPS ON THE COMPENSATORY TRACKING DEVICE.

(T = Trial)

<u>20 Social Subjects</u>		<u>12 Registry Subjects</u>	
$T_3 : T_1 = 1.64^{**}$		$T_1 : T_3 = 1.14$	
$T_4 : T_1 = 6.25^{**}$		$T_4 : T_1 = 2.95^{**}$	
$T_4 : T_7 = 4.39^{**}$		$T_4 : T_7 = 2.71^{**}$	
$T_3 : T_7 = 1.16$		$T_7 : T_3 = 1.24$	
$T_7 : T_1 = 1.42^*$		$T_7 : T_1 = 1.09$	

* $p < 0.05$.

** $p < 0.01$.

Discussion of Results for the Compensatory Tracking Device

1. The same subjects were tested on this device as on the Pursuit Tracking and the results were very similar.
2. Under elevated BAQ levels subjects in each group tracked more poorly than under reduced or zero BAQ levels.
3. There was no statistical difference in performance between the social and registry subjects.
4. Both groups showed a significant correlation between BAQ and performance.
5. Variance in tracking is greater for subjects with elevated BAQ levels than for reduced BAQ levels.

4.2.6 Complex Reaction Tester (Comp. Test)

In this task, two lights appeared, one above the other on both sides of a display panel. A response button is on each end of the panel. If the lower light were presented, the subject's task was to respond by depressing the button on the opposite side to that of the stimulus. If the upper light were presented, the subject responded by pressing the button on the same side as the stimulus. (See page 9.) for an illustration of subjects' task on this device.) There

were 3 dependent variables in this task; the total reaction time (measured in milliseconds) to responses made on the same side and opposite side, and the total number of errors. A total of 8 stimuli from both sides was presented. An error was counted if the subject either depressed the incorrect response button, or if he took longer than 0.9 second to respond.

The following subjects were tested on the Comp. Test device:

- 12 male social subjects
- 5 female social subjects
- 2 male control
- 1 female control
- 1 registry female

Because of the relatively few number of subjects, data are inconclusive on the last 3 groups of subjects described; the male and female control subjects and the registry female subject. The control subjects have been combined, and data for this combined group as well as the registry female subject are presented in Tables VIII and IX of Appendix A.

Summary of Reaction Time Data

Tables 27 and 28 present a summary of the data for reaction time made for the same and opposite side responses. Figures 12 and 13 show a comparison of results to responding for the same and opposite sides by 12 male social and 5 female social subjects respectively. In both males and females no significant difference was found between the reaction time scores to the stimulus requiring response on the same or opposite sides. Further, no difference was found between male and female performance.

Analysis of variance for the 12 male social drinkers showed a significant statistical difference between the 7 means tested both on the same ($p < 0.01$) and opposite ($p < 0.05$) reaction times. These results are presented in Tables 29 and 30 respectively. Tukey W-S-D tests after analysis of variance for 12 male social subjects showed that for the same reaction time measure no statistical difference existed between the control (Trial 1) and Trial 4 (highest BAQ levels) but that the same side reaction time score on Trial 4 was significantly slower than on Trial 7. Reaction time on the opposite side measure was slowest under the control condition (Trial 1) but was not statistically different from reaction time on Trial 4 (highest BAQ level). Performance on Trial 7 was significantly faster than at all other levels.

TABLE 27. SUMMARY OF ANALYSES FOR COMP. TEST DEVICE.

Dependent variable is reaction time (opposite side) in milliseconds. The 21 subjects tested are grouped as indicated.

1 Registry Subject (female) - Correlation (Performance and BAQ) = 0.397**

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.025	0.060	0.065	0.155	0.115	0.075	0.05
<u>Mean Re- action Time</u>	315.80	315.80	292.40	341.60	319.20	316.40	325.60
<u>Standard Deviation</u>	16.81	21.16	8.85	28.38	34.72	22.03	41.63
<u>Total Test Trials</u>	5	5	5	5	5	5	5

17 Social Subjects - Correlation (Performance and BAQ) = 0.012

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.000	0.034	0.086	0.110	0.081	0.057	0.039
<u>Mean Re- action Time</u>	293.60	278.57	289.01	294.05	282.66	269.37	260.57
<u>Standard Deviation</u>	98.31	51.85	42.99	49.96	39.60	38.89	41.70
<u>Total Test Trials</u>	85	85	85	85	80	85	85

12 Male Social Subjects - Correlation (Performance and BAQ) = 0.015

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.000	0.034	0.085	0.107	0.082	0.054	0.039
<u>Mean Re- action Time</u>	305.85	283.87	297.26	297.60	280.68	271.90	262.85
<u>Standard Deviation</u>	114.19	58.74	45.25	47.44	41.12	42.66	46.30
<u>Total Test Trials</u>	60	60	60	60	60	60	60

TABLE 27--(Continued)

6 Female Subjects - Correlation (Performance and BAQ) = 0.295*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.004	0.038	0.086	0.116	0.086	0.066	0.042
<u>Mean Re- action Time</u>	272.80	274.17	273.07	294.87	294.72	272.17	266.83
<u>Standard Deviation</u>	28.89	31.45	28.18	41.83	36.37	33.24	39.90
<u>Total Test Trials</u>	30	30	30	30	25	30	30

5 Female Social Subjects - Correlation (Performance and BAQ) = 0.222*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.000	0.033	0.090	0.117	0.080	0.064	0.040
<u>Mean Re- action Time</u>	264.20	265.84	269.20	285.52	288.60	263.32	255.08
<u>Standard Deviation</u>	22.37	26.22	29.21	37.87	34.93	27.66	27.78
<u>Total Test Trials</u>	25	25	25	25	20	25	25

18 Total Test Subjects - Correlation (Performance and BAQ) = 0.046

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.001	0.035	0.085	0.112	0.083	0.058	0.040
<u>Mean Re- action Time</u>	294.83	280.64	289.20	296.69	284.41	271.99	264.18
<u>Standard Deviation</u>	95.72	51.29	41.81	45.43	40.09	39.58	44.09
<u>Total Test Trials</u>	90	90	90	90	85	90	90

TABLE 27--(Continued)

2 Control Male Subjects

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>Mean Re-</u> <u>action Time</u>	276.00	265.90	286.60	295.30	268.10	252.70	246.50
<u>Standard</u> <u>Deviation</u>	27.79	14.11	24.76	33.01	31.87	42.69	21.06
<u>Total</u> <u>Test Trials</u>	10	10	10	10	10	10	10

1 Control Female Subject

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>Mean Re-</u> <u>action Time</u>	281.20	252.80	238.60	277.60	278.60	266.00	270.00
<u>Standard</u> <u>Deviation</u>	10.94	12.83	23.67	43.34	34.85	19.39	18.07
<u>Total</u> <u>Test Trials</u>	5	5	5	5	5	5	5

* $p < 0.01$.** $p < 0.02$.

TABLE 28. SUMMARY OF ANALYSES FOR COMP. TEST DEVICE.

Dependent variable is reaction time (same side) in milli-seconds. The 21 subjects tested are grouped as indicated.

1 Registry subject (Female) - Correlation (Performance and BAQ) = 0.450**

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.025	0.060	0.065	0.155	0.115	0.075	0.05
<u>Mean Re- action Time</u>	272.60	280.60	252.80	304.40	288.00	293.20	257.40
<u>Standard Deviation</u>	21.10	23.16	9.58	21.92	31.07	36.53	22.01
<u>Total Test Trials</u>	5	5	5	5	5	5	5

17 Social Subjects - Correlation (Performance and BAQ) = 0.101***

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.000	0.034	0.086	0.110	0.081	0.057	0.039
<u>Mean Re- action Time</u>	277.58	275.19	280.95	291.54	278.90	268.02	259.45
<u>Standard Deviation</u>	38.52	36.62	40.98	48.11	44.87	44.28	41.92
<u>Total Test Trials</u>	85	85	85	85	80	85	85

12 Male Social Subjects - Correlation (Performance and BAQ) = 0.088

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.000	0.034	0.085	0.107	0.082	0.054	0.039
<u>Mean Re- action Time</u>	282.23	277.17	287.32	294.00	279.17	264.47	258.50
<u>Standard Deviation</u>	40.79	37.54	43.35	50.96	47.66	46.76	45.25
<u>Total Test Trials</u>	60	60	60	60	60	60	60

TABLE 28--(Continued)

6 Female Subjects - Correlation (Performance and BAQ) = 0.238*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.004	0.038	0.086	0.116	0.086	0.066	0.042
<u>Mean Re-</u> <u>action Time</u>	267.43	272.13	263.70	288.77	280.08	279.33	261.00
<u>Standard</u> <u>Deviation</u>	28.76	32.86	28.08	38.67	34.92	36.94	31.52
<u>Total</u> <u>Test Trials</u>	30	30	30	30	25	30	30

5 Female Social Subjects - Correlation (Performance and BAQ) = 0.155

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.000	0.033	0.090	0.117	0.080	0.064	0.040
<u>Mean Re-</u> <u>action Time</u>	266.40	270.44	265.68	285.64	278.10	276.56	261.72
<u>Standard</u> <u>Deviation</u>	30.30	34.60	30.21	40.81	36.28	37.13	33.30
<u>Total</u> <u>Test Trials</u>	25	25	25	25	20	25	25

18 Total Test Subjects - Correlation (Performance and BAQ) = 0.115*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.001	0.035	0.085	0.112	0.083	0.058	0.040
<u>Mean Re-</u> <u>action Time</u>	277	277.90	283.84	298.81	278.26	271.11	262.17
<u>Standard</u> <u>Deviation</u>	37.67	36.10	41.38	47.54	44.11	43.91	40.99
<u>Total</u> <u>Test Trials</u>	90	90	90	90	85	90	90

TABLE 28---(Continued)

2 Control Male Subjects

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>Mean Re-</u> <u>action Time</u>	277.10	256.70	243.40	256.50	258.80	245.50	255.90
<u>Standard</u> <u>Deviation</u>	37.17	44.81	44.11	56.37	61.03	35.43	40.96
<u>Total</u> <u>Test Trials</u>	10	10	10	10	10	10	10

1 Control Female Subject

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>Mean Re-</u> <u>action Time</u>	292.40	297.20	250.00	285.60	283.60	253.00	273.20
<u>Standard</u> <u>Deviation</u>	39.20	33.12	20.04	37.39	24.83	28.64	26.52
<u>Total</u> <u>Test Trials</u>	5	5	5	5	5	5	5

*p < 0.01.

**p < 0.02.

***p < 0.05.

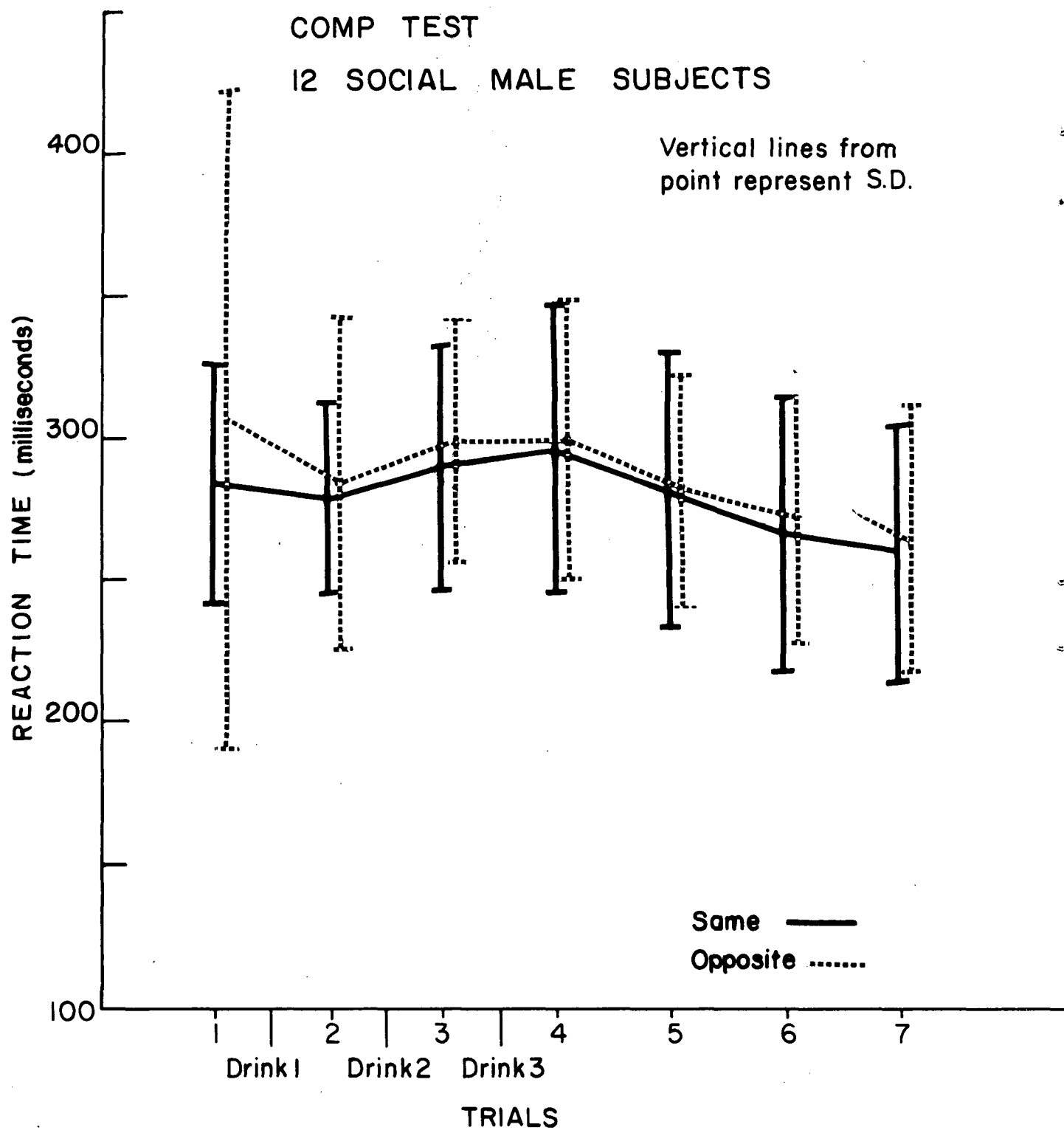


Figure 12. Relation between performance and test trials to the same and opposite side responses on the Comp. Test device for 12 social male subjects. (Curves displaced for clarity.)

COMP TEST

5 FEMALE SOCIAL SUBJECTS

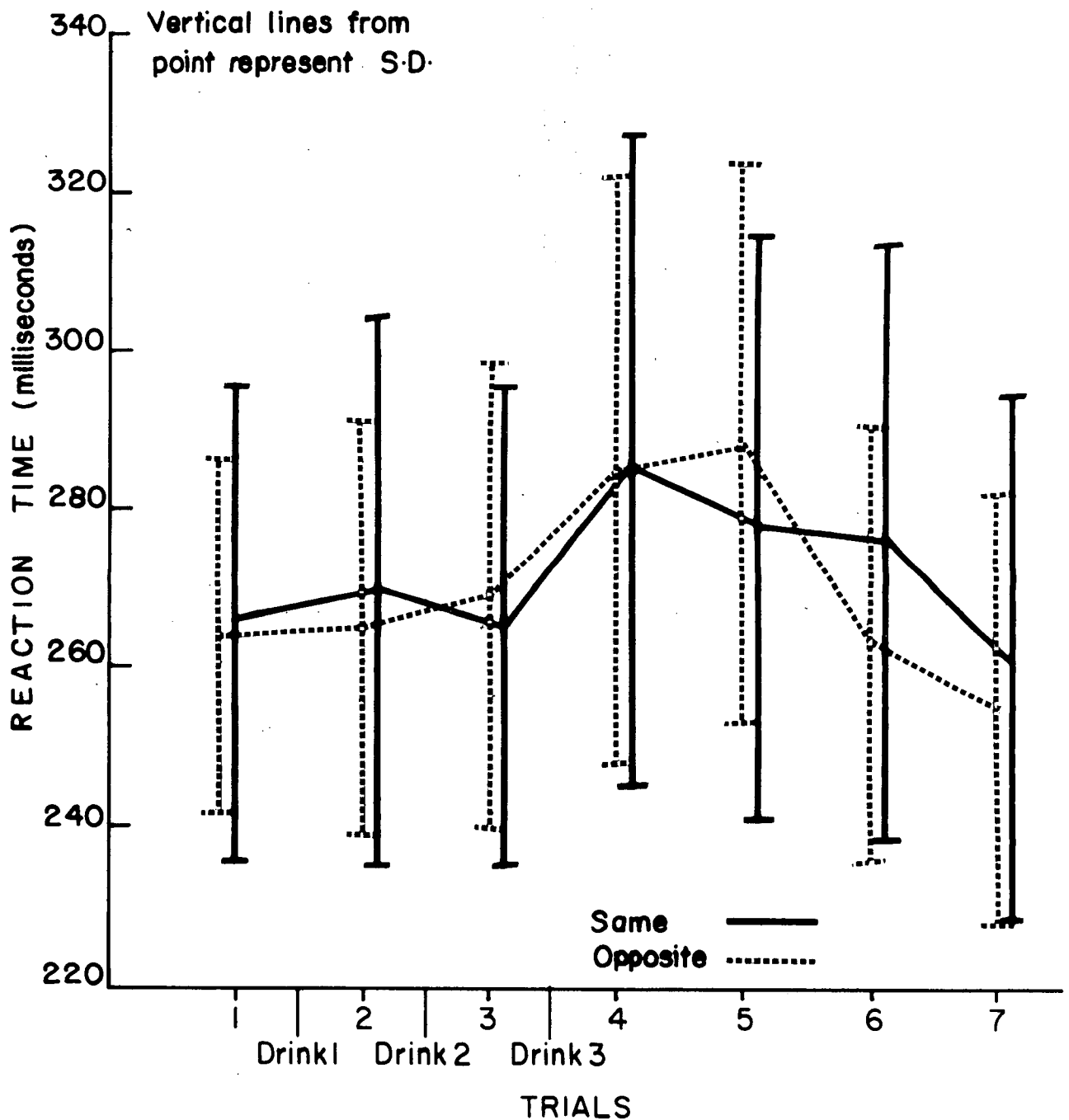


Figure 13. Relation between performance and test trials to the same and opposite side responses on the Comp. Test device for 5 social female subjects. (Curves displaced for clarity.)

TABLE 29. SUMMARY OF ANALYSIS OF VARIANCE FOR 12 MALE SOCIAL SUBJECTS TESTED ON THE SAME REACTION TIME MEASURE ON THE COMP. TEST DEVICE.

<u>Sources of Variance</u>	<u>degrees of freedom</u>	<u>Sums of Squares</u>	<u>Mean Square</u>	<u>F ratio</u>
Total	419	884,572.0	2,111.15	
Repetitions (R)	4	1,196.0	299.00	
Trials (T)	6	55,480.0	9,246.67	6.87*
Subjects (S)	11	540,424.0	49,129.44	
R x T	24	11,068.0	461.17	
R x S	44	23,296.0	529.45	
T x S	66	88,884.0	1,346.73	
R x T x S	264	164,224.0	622.06	

* $p < 0.01$.

TABLE 30. SUMMARY OF ANALYSIS OF VARIANCE FOR 12 MALE SOCIAL SUBJECTS TESTED ON THE OPPOSITE REACTION TIME MEASURE ON THE COMP. TEST DEVICE.

<u>Sources of Variance</u>	<u>degrees of freedom</u>	<u>Sums of Squares</u>	<u>Mean Square</u>	<u>F ratio</u>
Total	419	1,645,264.0	3,926.64	
Repetitions (R)	4	14,848.0	3,712.00	1.62
Trials (T)	6	85,344.0	14,224.0	2.45*
Subjects (S)	11	556,688.0	50,607.99	
R x T	24	42,128.0	1,755.33	
R x S	44	100,824.0	2,291.45	
T x S	66	383,704.0	5,813.70	
R x T x S	264	461,728.0	1,748.97	

* $p < 0.05$.

Analysis of variance for 5 female social subjects showed only a significant difference over trials on the opposite reaction time measure. No significant F tests were found for the mean performance over the same reaction time measure. These results are summarized in Table 31 and Table X, Appendix A respectively.

TABLE 31. SUMMARY OF ANALYSIS OF VARIANCE FOR 5 FEMALE SOCIAL SUBJECTS TESTED ON THE OPPOSITE REACTION TIME MEASURE ON THE COMP. TEST DEVICE.

<u>Sources of Variance</u>	<u>degrees of freedom</u>	<u>Sums of Squares</u>	<u>Mean Square</u>	<u>F ratio</u>
Total	174	164,345.0	944.56	
Repetitions (R)	4	2,454.0	613.50	
Trials (T)	6	20,894.0	3,482.33	4.84*
Subjects (S)	4	68,508.0	17,127.00	
R x T	24	10,768.0	448.67	
R x S	16	5,372.0	335.75	
T x S	24	17,258.0	719.08	
R x T x S	96	39,100.0	407.29	

* $p < 0.01$.

In female social drinkers, the Tukey W-S-D test showed a statistically significant difference ($p < 0.05$) for means made on Trials 4 and 5 of the opposite reaction time measure. These means were greater than for all other levels. No other means were significantly different from each other.

Summary of Error Data

A summary of analyses of the number of errors made on the Comp. Test device for all subjects tested is presented in Table 32. Figures 14 and 15 show the relation of error performance to trials for the 12 male social subjects and 5 female subjects tested on the Comp. Test device. It is evident from Figure 14 that the number of errors is greatest on Trial 4, the trial with the highest BAQ levels and less at all other levels. An analysis of variance on error data for the 12 male social subjects showed a significant F ratio for the 7 test trials (Table 33). The Tukey W-S-D test for mean differences showed that the mean number of

TABLE 32. SUMMARY OF ANALYSES FOR COMP. TEST DEVICE.

Dependent variable is total number of errors. The 21 subjects tested are grouped as indicated.

1 Registry Subject (Female) - Correlation (Performance and BAQ) = 0.231

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.025	0.060	0.065	0.155	0.115	0.075	0.05
<u>Mean Error</u>	1.00	1.00	0.20	1.40	1.00	1.00	0.20
<u>Standard Deviation</u>	0.707	0.707	0.447	1.673	0.707	0.707	0.447
<u>Total Test Trials</u>	5	5	5	5	5	5	5

17 Social Subjects - Correlation (Performance and BAQ) = 0.152*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.000	0.034	0.086	0.110	0.081	0.057	0.039
<u>Mean Error</u>	0.776	0.671	1.459	1.894	1.537	0.635	1.035
<u>Standard Deviation</u>	1.383	0.905	2.174	2.924	2.850	0.911	2.079
<u>Total Test Trials</u>	85	85	85	85	80	85	85

12 Male Subjects - Correlation (Performance and BAQ) = 0.163*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.000	0.034	0.085	0.107	0.082	0.054	0.039
<u>Mean Error</u>	0.95	0.75	1.40	1.62	1.20	0.75	0.90
<u>Standard Deviation</u>	1.545	0.968	1.532	1.530	1.459	1.002	1.311
<u>Total Test Trials</u>	60	60	60	60	60	60	60

TABLE 32--(Continued)

6 Female Subjects - Correlation (Performance and BAQ) = 0.218*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.004	0.038	0.086	0.116	0.086	0.066	0.042
<u>Mean Error</u>	0.467	0.567	0.467	0.867	0.800	0.467	0.267
<u>Standard Deviation</u>	0.776	0.723	0.822	1.076	0.913	0.682	0.454
<u>Total Test Trials</u>	30	30	30	30	25	30	30

5 Female Social Subjects - Correlation (Performance and BAQ) = 0.188**

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.000	0.033	0.090	0.117	0.080	0.064	0.040
<u>Mean Error</u>	0.36	0.48	0.52	0.76	0.75	0.36	0.28
<u>Standard Deviation</u>	0.757	0.714	0.872	0.926	0.851	0.569	0.458
<u>Total Test Trials</u>	25	25	25	25	20	25	25

18 Total Test Subjects - Correlation (Performance and BAQ) = 0.153*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.001	0.035	0.085	0.112	0.083	0.058	0.040
<u>Mean Error</u>	0.789	0.689	1.089	1.369	1.082	0.656	0.689
<u>Standard Deviation</u>	1.353	0.895	1.404	1.434	1.329	0.914	1.138
<u>Total Test Trials</u>	90	90	90	90	85	90	90

TABLE 32--(Continued)

2 Control Male Subjects

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>Mean Error</u>	0.80	0.50	0.70	1.30	0.70	0.60	0.60
<u>Standard Deviation</u>	0.79	0.53	0.82	1.06	1.06	0.70	0.52
<u>Total Test Trials</u>	10	10	10	10	10	10	10

1 Control Female Subject

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>Mean Error</u>	0.40	0.20	0.40	1.00	1.60	0.60	1.20
<u>Standard Deviation</u>	0.55	0.45	0.55	1.73	0.89	0.55	0.84
<u>Total Test Trials</u>	5	5	5	5	5	5	5

* $p < 0.01$.** $p < 0.05$.

COMP TEST

12 MALE SOCIAL SUBJECTS

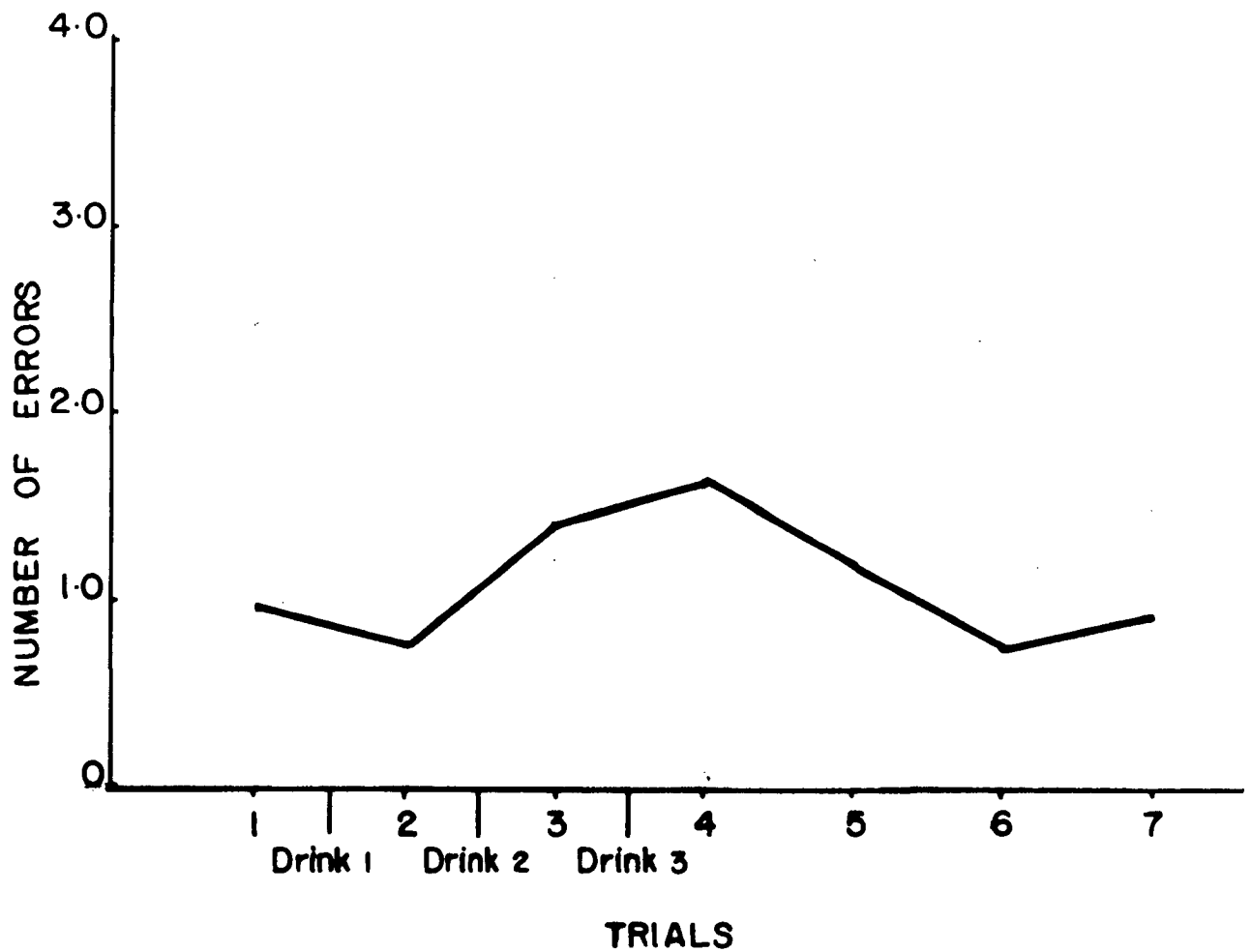


Figure 14. Relation between performance and test trials on error performance on the Comp. Test device for 12 social male subjects.

COMP TEST

5 FEMALE SOCIAL SUBJECTS

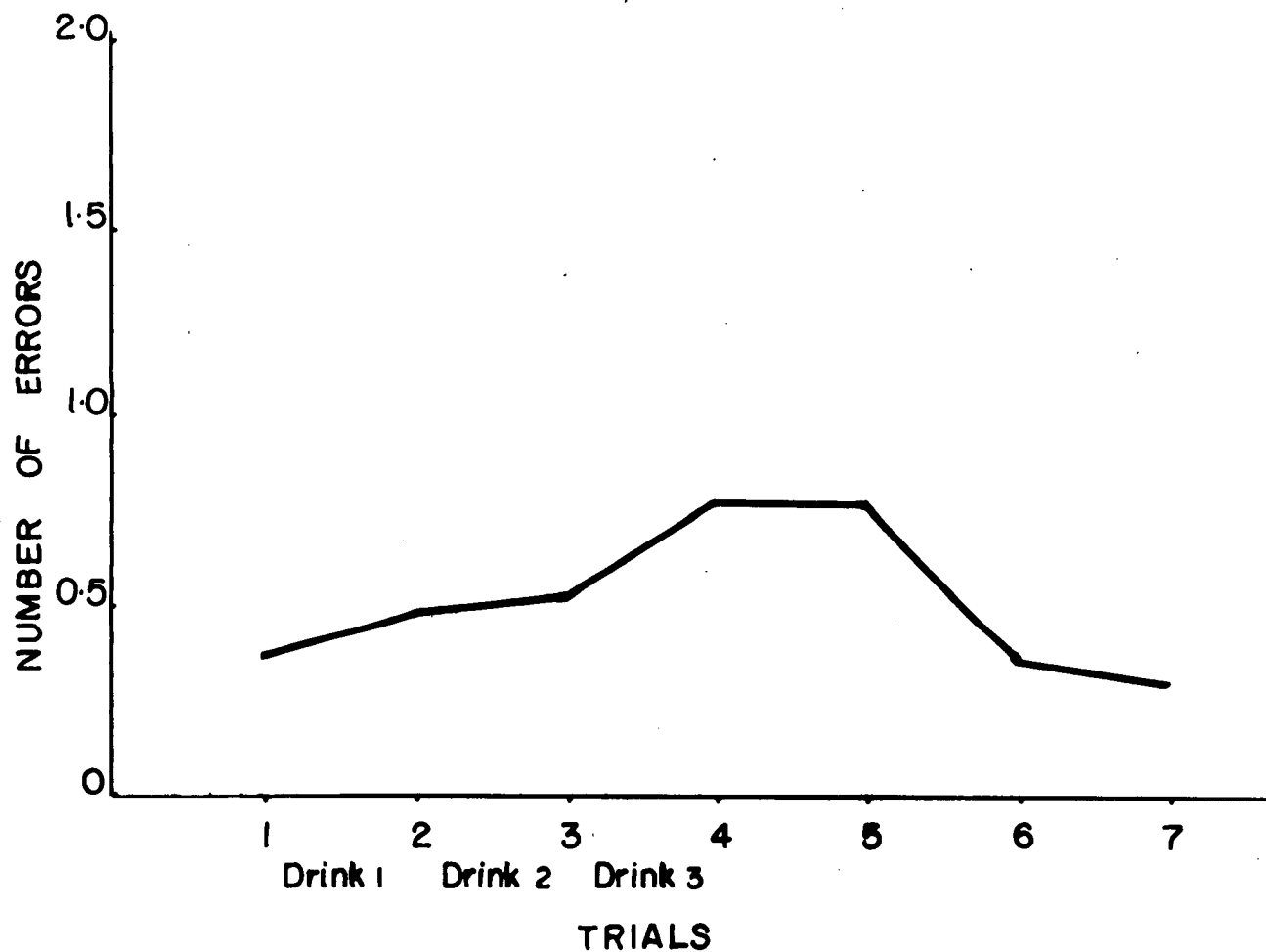


Figure 15. Relation between performance and test trials on error performance on the Comp. Test device for 5 female social subjects.

TABLE 33. SUMMARY OF ANALYSIS OF VARIANCE FOR 12 MALE SOCIAL SUBJECTS TESTED ON THE NUMBER OF ERRORS MADE ON THE COMP. TEST DEVICE.

<u>Sources of Variance</u>	<u>degrees of freedom</u>	<u>Sums of Squares</u>	<u>Mean Squares</u>	<u>F ratio</u>
Total	419	799.25	1.91	
Repetitions (R)	4	7.25	1.81	
Trials (T)	6	40.31	6.72	3.56*
Subjects (S)	11	342.28	31.12	
R x T	24	20.02	0.83	
R x S	44	46.01	1.05	
T x S	66	124.66	1.89	
R x T x S	264	218.73	0.83	

* $p < 0.01$.

errors made on Trial 4 was significantly greater than on all other trials. No other means were significantly different from each other. Although the number of errors was greatest on Trial 4 for the 5 female social subjects tested (Figure 15) this was not a significant finding. A summary of the analysis of variance on the 5 female social subjects tested on the Comp. Test device is presented in Table XI Appendix A. A "t" test showed that the male social subjects made more errors than the 5 female subjects ($p < 0.01$) or the 3 control subjects ($p < 0.05$) tested.

Correlations were obtained between BAQ and performance for each of the 3 measures obtained for the 12 male social and 5 female subjects tested on the Comp. Test device. Results show that there were significant correlations between BAQ and each of the measures of performance for the 5 social female subjects, while for the 12 male social subjects, a significant relation was shown only with the errors measure. These results are summarized in Table 34.

A series of F tests was made to determine whether there was a difference in variability of response under the highest alcohol level (Trial 4) as compared with the lowest BAQ levels (Trials 1 and 7). Results were highly inconsistent. For the 12 male social subjects tested on the same reaction time measure, variance on Trial 4 was significantly greater than on Trial 1 ($p < 0.05$). On the opposite reaction time

TABLE 34. CORRELATIONS BETWEEN BAQ AND PERFORMANCE ON THE COMP. TEST DEVICE FOR THE MALE AND FEMALE SOCIAL SUBJECTS TESTED.

	<u>Male Social</u>	<u>Female Social</u>
Same Reaction Time	0.085	0.154*
Opposite Reaction Time	0.018	0.220***
Errors	0.139*	0.188**

* $p < 0.05$.

** $p < 0.025$.

*** $p < 0.001$.

measure, the variance on Trial 1 was much larger than on Trials 4 and 7 ($p < 0.01$). For the 5 female social subjects on the opposite reaction time measure the variance on Trial 4 was significantly greater than on Trial 1 ($p < 0.01$) while on the error measure for the same subjects the variance on Trial 4 was significantly greater than on Trial 7. However, the variance on Trial 1 was greater than on Trial 7 ($p < 0.05$). No other variances were significant. A summary of these results is presented in Table 35.

Discussion of Results for the Complex Reaction Tester Device

1. The Comp. Test device measured 3 dependent variables; the number of errors, the total reaction time for responding on both the same and opposite sides in relation to where the stimulus was presented.

2. Only 1 registry female subject was tested, so interpretation of results would be inconclusive.

3. The overall means for reaction time on the same and opposite sides for the 12 male social and 5 female social subjects as well as the control subjects were not significantly different from each other. However, the male social subjects made more errors than either the female social or control subjects.

4. Mean reaction times were generally slower under elevated BAQ levels. Errors were higher under increased BAQ levels only for the 12 male social subjects. Male social subjects responded generally faster under a slightly elevated level (approximately 0.04) than in a no alcohol situation.

TABLE 35. SUMMARY OF F TESTS FOR DIFFERENCES IN VARIANCE BETWEEN INDICATED TRIALS, GROUPS, AND MEASURES ON THE COMP. TEST DEVICE.

(T = Trials)

12 Male Social Subjects			5 Female Social Subjects		
<u>Same Reaction Time</u>	<u>Opposite Reaction Time</u>	<u>Number Errors</u>	<u>Same Reaction Time</u>	<u>Opposite Reaction Time</u>	<u>Number Errors</u>
$T_3 : T_1 = 1.13$	$T_1 : T_3 = 6.37^{**}$	$T_1 : T_3 = 1.02$	$T_1 : T_3 = 1.01$	$T_3 : T_1 = 1.70$	$T_3 : T_1 = 1.33$
$T_4 : T_1 = 1.56^*$	$T_1 : T_4 = 5.79$	$T_1 : T_4 = 1.02$	$T_4 : T_1 = 1.81$	$T_4 : T_1 = 2.86^{**}$	$T_4 : T_1 = 1.50$
$T_4 : T_7 = 1.27$	$T_4 : T_4 = 1.05$	$T_4 : T_7 = 1.36$	$T_4 : T_7 = 1.50$	$T_4 : T_7 = 1.86$	$T_4 : T_7 = 4.08^{**}$
$T_7 : T_3 = 1.09$	$T_7 : T_3 = 1.05$	$T_3 : T_7 = 1.36$	$T_7 : T_3 = 1.22$	$T_3 : T_7 = 1.11$	$T_3 : T_7 = 3.62^{**}$
$T_7 : T_1 = 1.23$	$T_1 : T_7 = 6.08^{**}$	$T_1 : T_7 = 1.39$	$T_7 : T_1 = 1.21$	$T_7 : T_1 = 1.54$	$T_1 : T_7 = 2.73^*$

* $p < 0.05$.

** $p < 0.01$.

5. Significant correlations between BAQ and all measures of performance were found for female social subjects. Male social subjects showed a relation only under the error measure of performance.

6. No consistency was found in the variability of responding under different BAQ levels.

4.2.7 Phystester Device

On this device the subjects' task was to reproduce a number of 5 digits that was presented for 1.5 seconds. While pressing a set of keys with the digits 0-9 an additional signal would appear and subjects had to press a foot pedal. If the pedal was not depressed or the number reproduced incorrectly the subject failed on that repetition. Subjects knew the results immediately after each repetition. According to a personal communication from Mr. Robert Lucas of Delco Electronics performance is more closely related to BAQ if only the first repetition within a test session is studied. Apparently the subject gains some training from an immediate past experience with this device. Therefore only the results of the first repetition of each sequence within each test session were analyzed and the number of passes for the first repetition became the dependent variable.

On this device the following subjects were tested:

- 3 female social
- 17 male social
- 9 male registry
- 3 female registry

A summary of the data analyses are presented in Table 36 and illustrated in Figures 16-18. Standard deviations have been marked as an aid to the reader, however with only four data points obtained, a normal distribution may not apply. Figure 16 shows a marked decrement in performance as BAQ levels increased to the maximum (Trial 4) for both male and female registry subjects. Similar results, although not as dramatic, occurred for 17 male social and 3 female social subjects (Fig. 17). Figure 18 shows an interesting picture. When performance is compared for 12 registry and 20 social subjects the social subjects performed consistently better on all trials than did the registry subjects. Further, the curves are almost parallel to each other which indicates that the changes in performance over trials with changes in BAQ levels was almost identical.

A "t" test was done to compare the mean performance between the 20 social and 12 registry subjects. The result

TABLE 36. SUMMARY OF ANALYSES FOR PHYSTESETER DEVICE.

Dependent variables is number of passes. The 32 subjects tested are grouped as indicated.

12 Registry Subjects - Correlation (Performance and BAQ) = 0.429*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.017	0.039	0.081	0.143	0.109	0.086	0.066
<u>Mean Correct</u>	2.17	2.17	1.58	0.92	1.67	1.92	1.83
<u>Standard Deviation</u>	1.11	0.84	0.99	0.79	1.07	0.90	0.94
<u>Total Test Trials</u>	12	12	12	12	12	12	12

20 Social Subjects - Correlation (Performance and BAQ) = 0.307*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.001	0.034	0.079	0.106	0.081	0.062	0.044
<u>Mean Correct</u>	3.35	2.75	2.30	1.70	2.75	2.75	2.50
<u>Standard Deviation</u>	0.81	1.48	1.59	1.42	1.37	1.12	1.28
<u>Total Test Trials</u>	20	20	20	20	20	20	18

26 Male Subjects - Correlation (Performance and BAQ) = 0.400*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.005	0.036	0.079	0.119	0.091	0.072	0.052
<u>Mean Correct</u>	2.85	2.50	2.04	1.38	2.15	2.42	2.19
<u>Standard Deviation</u>	1.19	1.27	1.54	1.33	1.38	1.21	1.20
<u>Total Test Trials</u>	26	26	26	26	26	26	24

TABLE 36--(Continued)

6 Female Subjects - Correlation (Performance and BAQ) = 0.385*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.018	0.038	0.082	0.124	0.093	0.067	0.049
<u>Mean Correct</u>	3.17	2.67	2.00	1.50	3.17	2.50	2.50
<u>Standard Deviation</u>	0.41	1.51	0.89	1.05	0.98	0.55	1.22
<u>Total Test Trials</u>	6	6	6	6	6	6	6

9 Male Registry Subjects - Correlation (Performance and BAQ) = 0.446*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.010	0.040	0.082	0.144	0.11	0.090	0.071
<u>Mean Correct</u>	1.89	2.00	1.44	0.89	1.22	1.78	1.67
<u>Standard Deviation</u>	1.166	0.867	1.010	0.781	0.831	0.970	0.866
<u>Total Test Trials</u>	9	9	9	9	9	9	9

3 Female Registry Subjects - Correlation (Performance and BAQ) = 0.421**

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.04	0.04	0.08	0.14	0.11	0.07	0.05
<u>Mean Correct</u>	3.00	2.67	2.00	1.00	3.00	2.33	2.33
<u>Standard Deviation</u>	0.00	0.592	1.00	1.00	0.00	0.592	1.162
<u>Total Test Trials</u>	3	3	3	3	3	3	3

TABLE 36--(Continued)

17 Male Social Subjects - Correlation (Performance and BAQ) = 0.308*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.001	0.033	0.078	0.105	0.081	0.062	0.043
<u>Mean Correct</u>	3.35	2.76	2.35	1.65	2.64	2.76	2.80
<u>Standard Deviation</u>	0.86	1.39	1.69	1.50	1.37	1.20	1.28
<u>Total Test Trials</u>	17	17	17	17	17	17	15

3 Female Social Subjects - Correlation (Performance and BAQ) = 0.312

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.00	0.04	0.076	0.11	0.082	0.062	0.047
<u>Mean Correct</u>	3.33	2.67	2.0	2.0	3.33	2.67	2.67
<u>Standard Deviation</u>	0.59	0.59	1.0	1.0	1.53	0.59	1.53
<u>Total Test Trials</u>	3	3	3	3	3	3	3

32 Total Subjects - Correlation (Performance and BAQ) = 0.393*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.007	0.036	0.080	0.120	0.091	0.071	0.052
<u>Mean Correct</u>	2.91	2.53	2.03	1.41	2.34	2.44	2.25
<u>Standard Deviation</u>	1.09	1.29	1.42	1.27	1.26	1.10	1.19
<u>Total Test Trials</u>	32	32	32	32	32	32	30

* $p < 0.005$.** $p < 0.01$.

PHYSTESTER

9 MALE REGISTRY AND 3 FEMALE REGISTRY

SUBJECTS

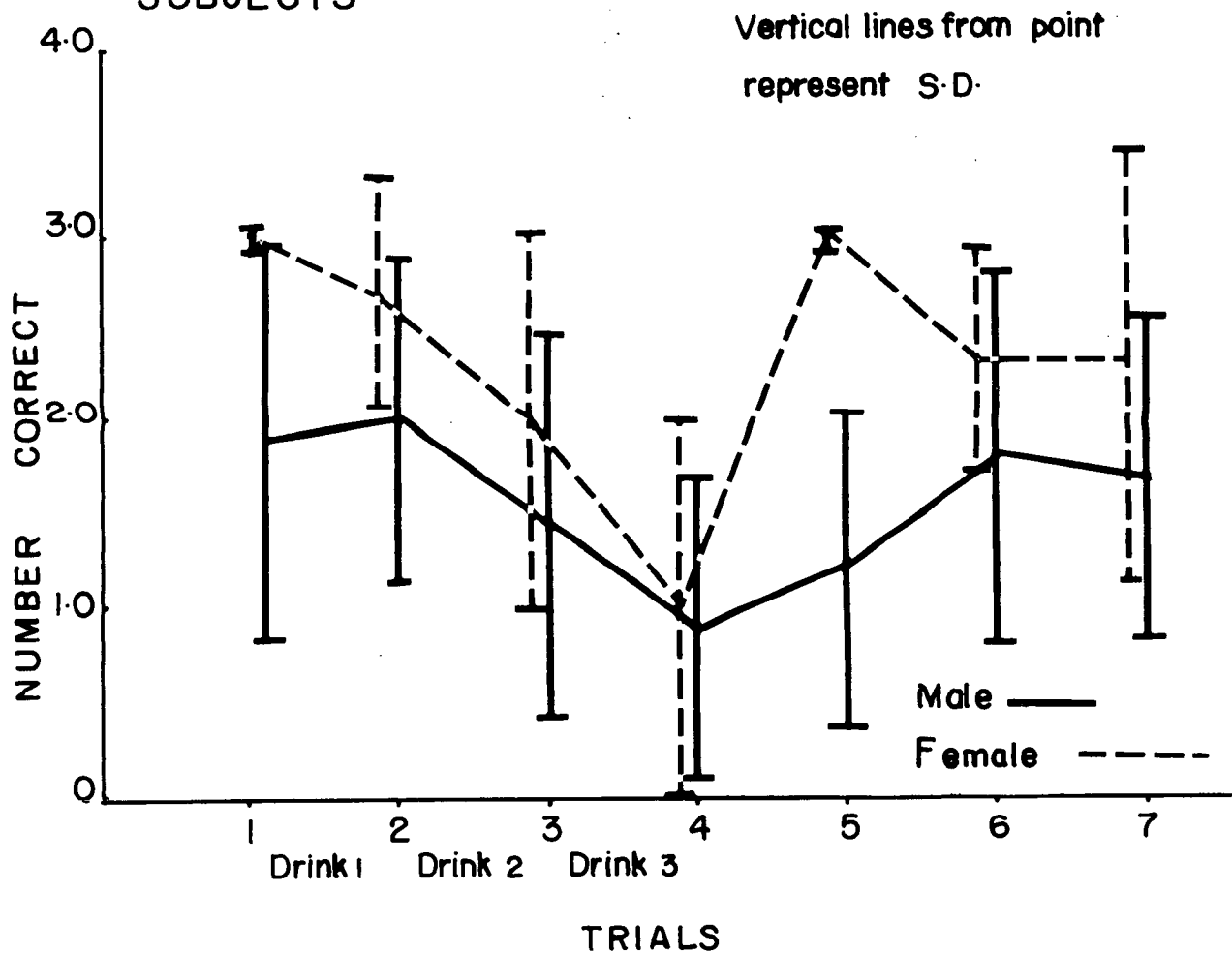


Figure 16. Relation between performance and test trials on the Phystester device for 9 male registry and 3 female registry subjects. (Curves displaced for clarity.)

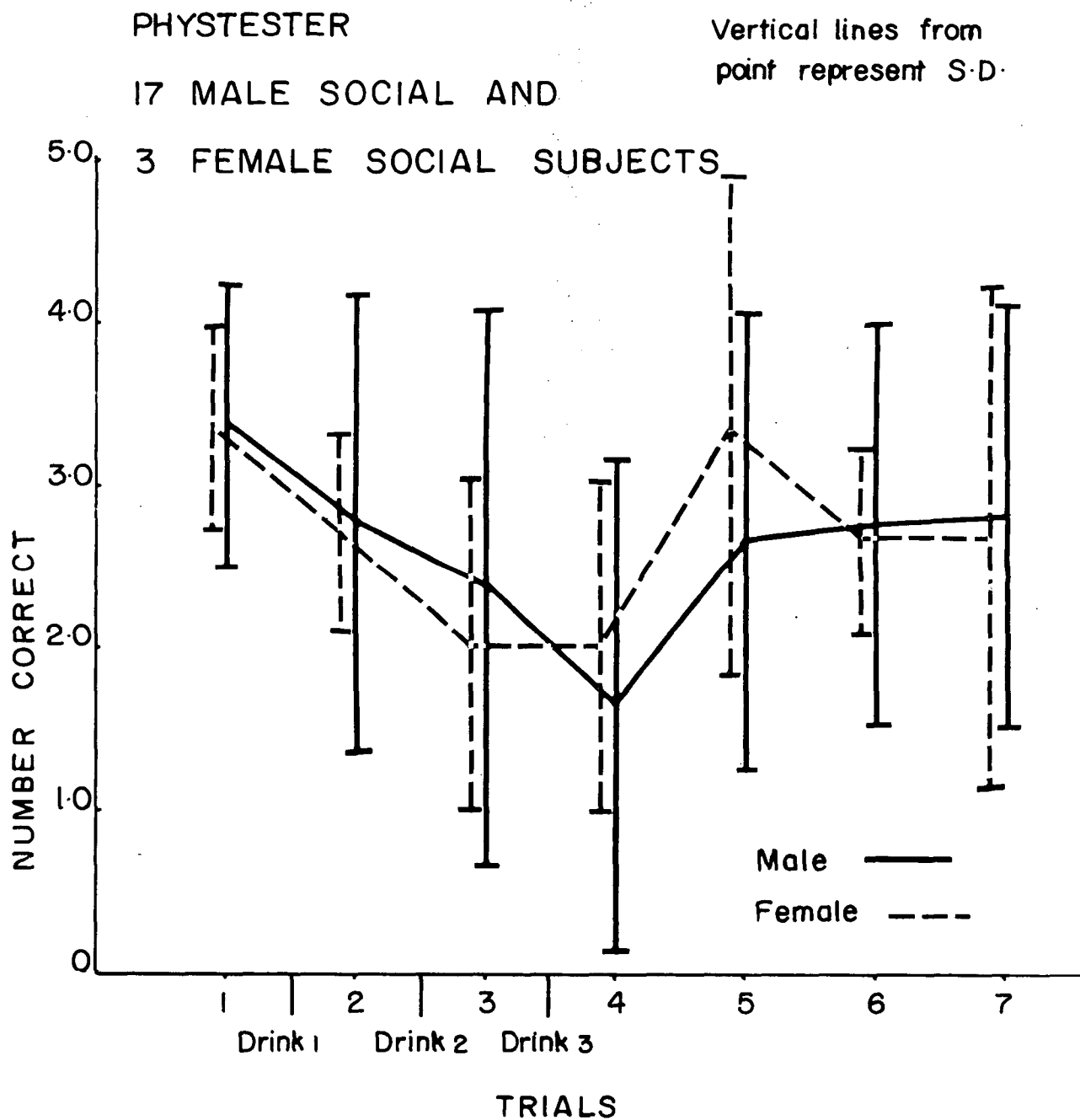


Figure 17. Relation between performance and test trials on the Phystester device for 17 male social and 3 female social subjects. (Curves displaced for clarity.)

PHYSTESTER

12 REGISTRY AND 20 SOCIAL SUBJECTS

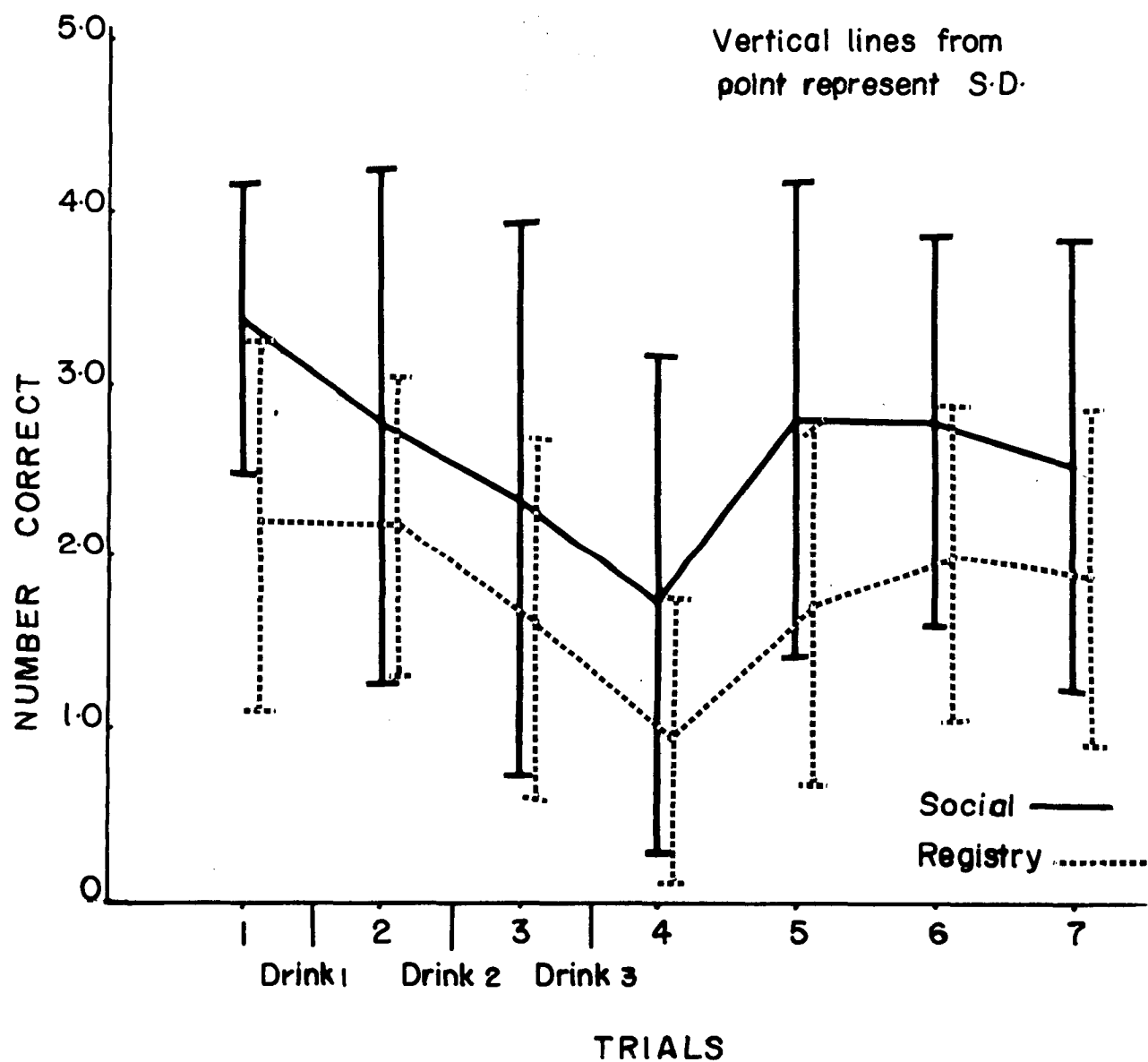


Figure 18. Relation between performance and test trials on the Phystester device for 12 registry and 20 social subjects.
(Curves displaced for clarity.)

showed that the social subjects performed significantly better than the registry subjects ($p < 0.025$).

A comparison of the variance between elevated BAQ levels and reduced and control conditions was made for the 12 registry and 20 social subjects. There was no difference in any of the variances for the 12 registry subjects while the 20 social subjects showed a significant difference in the variance between Trials 3 and 4 as compared to Trial 1. Further variance in Trial 7 was significantly greater than on Trial 1. The results are summarized in Table 37.

TABLE 37. SUMMARY OF F TESTS FOR DIFFERENCES IN VARIANCE BETWEEN INDICATED TRIALS AND GROUPS ON THE PHYSTEster DEVICE.

(T = Trial)

<u>20 Social Subjects</u>	<u>12 Registry Subjects</u>
$T_3 : T_1 = 3.83^{**}$	$T_1 : T_3 = 1.26$
$T_4 : T_1 = 3.06^{**}$	$T_1 : T_4 = 1.98$
$T_4 : T_7 = 1.23$	$T_7 : T_4 = 1.42$
$T_3 : T_7 = 1.54$	$T_3 : T_7 = 1.11$
$T_7 : T_1 = 2.48^*$	$T_1 : T_7 = 1.40$

* $p < 0.05$.

** $p < 0.01$

Discussion of Results for the Phystester Device

1. Four groups of subjects were tested: 17 male and 3 female social subjects and 9 male and 3 female registry subjects.

2. A relation was found between BAQ and performance for all subject groups. These findings were much more evident when only the first repetition of each test period was studied (Fig. 16-18). Apparently, performance improved through the repetitions of testing at each trial.

3. A "t" test showed that mean performance for the 20 social drinkers was significantly greater than for the 12 registry subjects.

4. Variability in performance for the social drinkers was greater at elevated BAQ levels when compared to control levels. No significant differences in variance occurred for the 12 registry subjects across all trials

4.2.8 QuicKey Device

On this device the subjects were required to pull their finger from a microswitch when a small light momentarily flashed on. The dependent variable was the time in milliseconds that it took for subjects to respond. The following subjects were tested on this device:

4 social female

6 social male

2 registry male

Even though the numbers of subjects were small, the results were impressive. These data are summarized in Table 38 and illustrated in Figures 19 and 20.

These figures show that performance was most markedly effected on Trial 4, the trial with the highest BAQ level for both the 6 male and 4 female social drinkers. Since one of the two registry male subjects became ill after Trial 3, no analysis was done on the data for the remaining subject. However, even in his case, performance was detrimentally effected at high BAQ levels.

Analysis of variance performed on the data showed very significant F ratios ($p < 0.001$) when means for the 7 test trials were compared. A summary of these analyses is presented in Tables 39 and 40.

A Tukey W-S-D test after analysis of variance showed that for the 6 male subjects Trial 4 was significantly poorer than all other means. For the 4 female subjects means on Trials 4 and 5 were significantly different from the other means, but not significantly different from each other.

A "t" test between the male and female social subjects showed no overall difference in performance.

TABLE 38. SUMMARY OF ANALYSES FOR QUICKEY DEVICE.

Dependent variable is reaction time in milliseconds. The 12 subjects tested are grouped as indicated.

2 Registry Subjects (both males) - Correlation (Performance and BAQ) = 0.440*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.00	0.04	0.095	0.14	0.11	0.10	0.08
<u>Mean Re- action Time</u>	213.54	228.44	236.95	284.33	277.67	277.83	274.57
<u>Standard Deviation</u>	35.75	32.86	41.92	44.74	45.65	45.30	42.39
<u>Total Test Trials</u>	60	60	60	30	30	30	30

10 Social Subjects - Correlation (Performance and BAQ) = 0.306*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.002	0.034	0.080	0.085	0.081	0.064	0.042
<u>Mean Re- action Time</u>	196.01	196.71	212.83	234.23	222.38	216.77	192.77
<u>Standard Deviation</u>	36.50	38.79	52.97	71.29	61.96	60.89	42.61
<u>Total Test Trials</u>	300	300	300	270	270	270	180

8 Male Subjects - Correlation (Performance and BAQ) = 0.405*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.00	0.039	0.090	0.101	0.090	0.079	0.058
<u>Mean Re- action Time</u>	195.45	202.24	224.19	242.78	228.89	225.51	201.55
<u>Standard Deviation</u>	37.45	38.39	54.24	71.69	67.45	66.44	52.44
<u>Total Test Trials</u>	240	240	240	210	210	210	150

TABLE 38--(Continued)

4 Female Subjects - Correlation (Performance and BAQ) = 0.131**

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.004	0.030	0.069	0.080	0.077	0.052	0.030
<u>Mean Re-</u> <u>action Time</u>	205.89	201.52	202.18	231.00	225.61	216.73	211.72
<u>Standard</u> <u>Deviation</u>	34.95	42.18	43.93	67.88	50.20	50.86	47.85
<u>Total</u> <u>Test Trials</u>	120	120	120	90	90	90	60

6 Male Social Subjects - Correlation (Performance and BAQ) = 0.390*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.00	0.039	0.088	0.088	0.083	0.072	0.050
<u>Mean Re-</u> <u>action Time</u>	189.42	193.50	219.93	235.85	220.76	216.79	183.30
<u>Standard</u> <u>Deviation</u>	36.12	36.12	57.24	73.07	67.15	65.47	36.40
<u>Total</u> <u>Test Trials</u>	180	180	180	180	180	180	120

12 Total Test Subjects - Correlation (Performance and BAQ) = 0.343*

<u>Trial</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>BAQ</u>	0.0013	0.0362	0.0828	0.0940	0.0885	0.0700	0.0483
<u>Mean Re-</u> <u>action Time</u>	199.30	202.28	217.29	240.00	227.31	222.49	204.55
<u>Standard</u> <u>Deviation</u>	37.83	41.78	51.33	68.20	62.83	62.36	51.22
<u>Total</u> <u>Test Trials</u>	360	360	360	300	300	300	210

*p < 0.001.

**p < 0.05.

QUICKEY

6 MALE SOCIAL SUBJECTS

Vertical lines : upper point represents 90th percentile
lower point represents 10th percentile

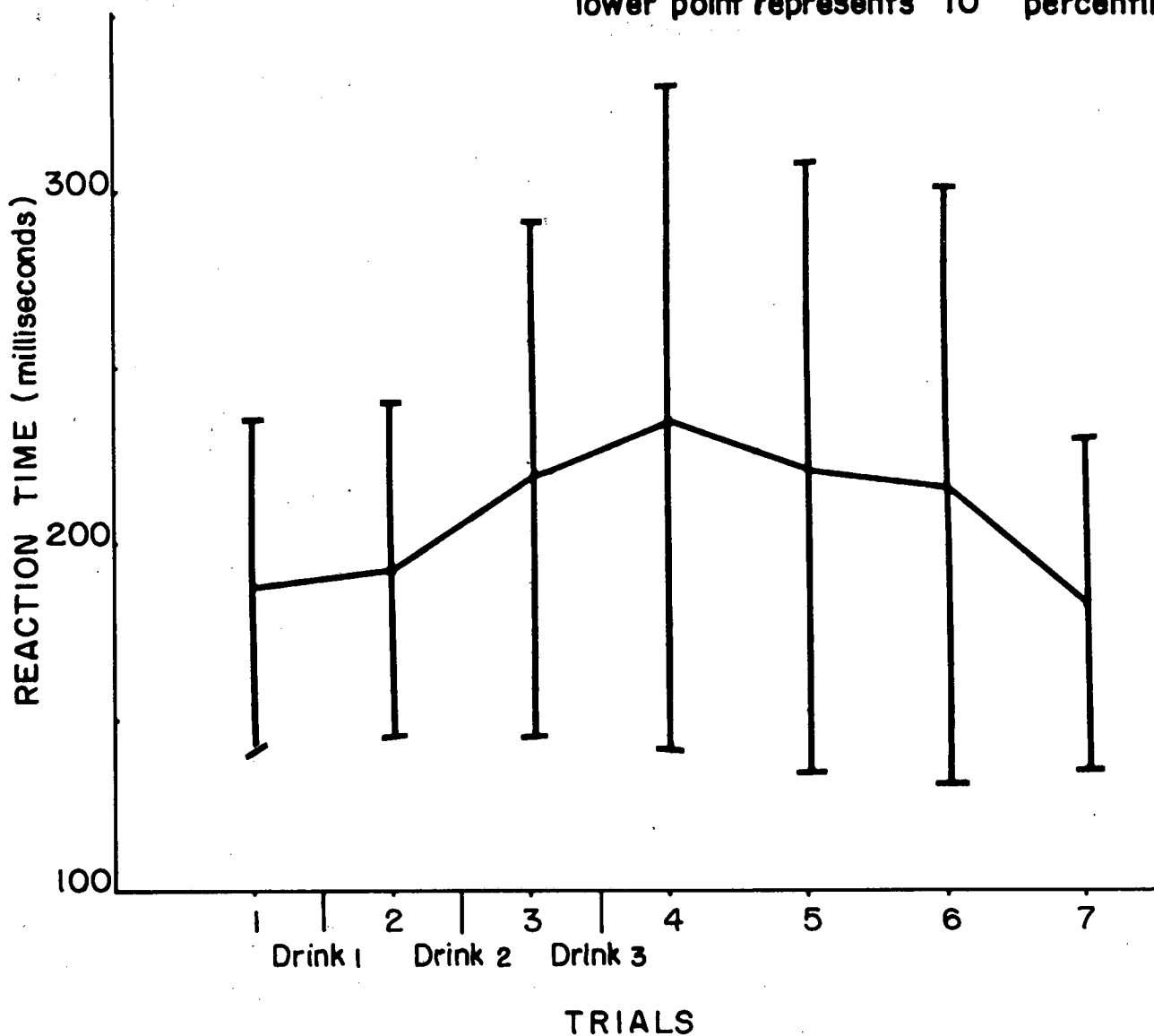


Figure 19. Relation between performance and test trials on the QuicKey device for 6 social male subjects.

QUICKEY

4 FEMALE SOCIAL SUBJECTS

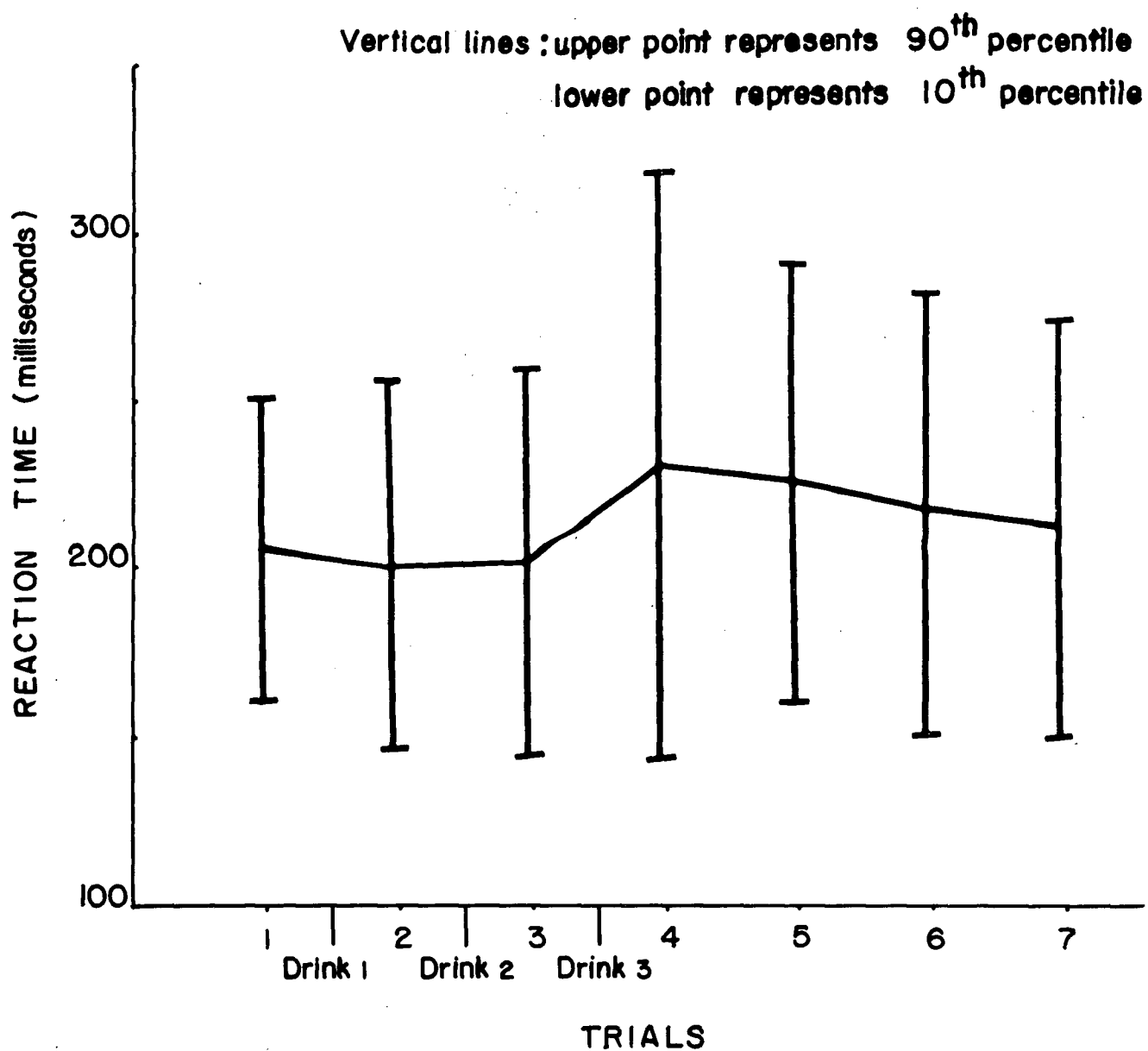


Figure 20. Relation between performance and test trials on the QuicKey device for 4 social female subjects.

TABLE 39. SUMMARY OF ANALYSIS OF VARIANCE FOR 6 MALE SOCIAL SUBJECTS
TESTED ON THE QUICKKEY DEVICE.

<u>Source of Variance</u>	<u>degrees of freedom</u>	<u>Sums of Squares</u>	<u>Mean Squares</u>	<u>F ratio</u>
Total	1,115	4,126,368.0	3,700.78	
Repetitions (R)	29	91,872.0	3,168.00	
Trials (T)	6	362,064.0	60,343.99	4.67*
Subjects (S)	5	1,076,768.0	215,353.56	
R x T	30	385,272.0	12,842.40	
R x S	145	351,192.0	2,422.01	
T x S	30	387,688.0	12,922.93	
R x T x S	870	1,471,512.0	1,691.39	

* $p < 0.001$.

TABLE 40. SUMMARY OF ANALYSIS OF VARIANCE FOR 4 FEMALE SOCIAL SUBJECTS
TESTED ON THE QUICKKEY DEVICE.

<u>Source of Variance</u>	<u>degrees of freedom</u>	<u>Sums of Squares</u>	<u>Mean Squares</u>	<u>F ratio</u>
Total	683	1,583,960.0	2,319.12	
Repetitions (R)	29	92,800.0	3,200.00	
Trials (T)	6	88,060.0	14,676.66	128.74*
Subjects (S)	3	74,108.0	24,702.66	
R x T	18	355,568.0	19,753.77	
R x S	87	228,496.0	2,626.39	
T x S	18	2,052.0	114.00	
R x T x S	522	742,876.0	1,423.13	

* $p < 0.001$.

A F comparison was made of the variance in responding for reduced and elevated BAQ levels for the 6 male and 4 female social subjects. The variance was significantly increased under elevated BAQ levels for both groups. The results are summarized in Table 41.

TABLE 41. SUMMARY OF F TESTS FOR DIFFERENCES IN VARIANCE BETWEEN INDICATED TRIALS AND GROUPS ON THE QUICKKEY DEVICE.

<u>6 Male Social Subjects</u>	<u>4 Female Social Subjects</u>
$T_3 : T_1 = 2.51^*$	$T_3 : T_1 = 1.58^*$
$T_4 : T_1 = 4.09^*$	$T_4 : T_1 = 3.77^*$
$T_4 : T_7 = 4.03^*$	$T_4 : T_7 = 2.01^*$
$T_3 : T_7 = 2.47^*$	$T_7 : T_3 = 1.19$
$T_1 : T_1 = 1.02$	$T_7 : T_1 = 1.87^*$

* $p < 0.01$.

Another correlation was done to make a comparative measure of the relation of performance to alcohol exposures. Previously performance had been correlated with breathalyzer values. As a comparison we took the ratio of the concentration of alcohol to body weight administered to each subject in the QuickKey device and correlated this ratio with performance. Further, in order to take into account the metabolism of alcohol by each subject after ingestion, a correction factor of 10 cc. per hour was used. Correlations were computed between these ratios and the mean of each trial for different groups of subjects and compared with the correlation of breathalyzer values (BAQ) to performance. There was initially no difference between the 3 correlations and performance. In one case, the ratio of concentration to body weight minus the correction was significantly less than using BAQ to performance for the 4 female social subjects. Results are presented in Table 42. Based on these results breathalyzer values appeared to be the best measure of alcohol exposure. The table of ratios of concentration of alcohol to body weight for each subject tested on this device is presented in Appendix B, Table VII.

TABLE 42. COMPARISON OF 3 DIFFERENT CORRELATIONS TO PERFORMANCE FOR DIFFERENT GROUPS TESTED ON THE QUICKKEY DEVICE.

	<u>BAQ</u>	<u>Concentration/ Body Weight</u>	<u>Concentration/Body Weight Correction</u>
Male Social	0.5228	0.5447	0.5093
Female Social	0.2238	0.2154	-0.0689
Registry	0.6521	0.7511	0.7178
Total	0.4815	0.4649	0.4064

Discussion of Results for the QuickKey Device

1. Performance, measured as a reaction time to a light was seriously effected as BAQ levels increased for 6 male and 4 female social drinkers.

2. Variability in performance was largest at the highest BAQ levels for both the 6 male and 4 female social subjects and significantly greater than reduced and zero BAQ levels.

3. No difference in performance resulted between the 6 male and 4 female social subjects.

4. There was no significant difference between the correlation of BAQ and performance and the ratio of alcohol concentration and performance. Therefore breathalyzer values were compared to performance whenever a comparison was made between alcohol exposure and performance.

4.2.9 Relation Between Intelligence and Performance

All subjects tested in Phase II (and in Phase III) were given either the Personnel Tests for Industry or the Wesman Personnel Classification Test. Both tests are copyrighted and published by The Psychological Corporation, 304 East 45th Street, New York 10017. There were several reasons for choosing these tests:

1. Subjects who did not attend college were given the Personnel Tests for Industry while those subjects with at least 1 year of college were given the Wesman Personnel Classification Test.

2. These tests can be grouped administered as opposed to many others, e.g., the Wechsler Adult Intelligence Scale.

3. These tests contain not only verbal but quantitative

items. Subjects who are raised in a foreign country or in a bilingual environment tend not to give a true measure of their intelligence as on an all-verbal test like the Otis. Some such subjects were included in this study.

In order to determine the distribution of IQ scores (recorded in percentiles) for all subjects in this phase of the study, individuals were divided into control, registry, and social groups and percentile scores recorded. Scores for each group are presented in Table VIII of Appendix B.

Several points should be made on these distributions:

- 1) The distributions are markedly skewed toward the upper end of intelligence.
- 2) Only 3 of 13 registry subjects had any college training. However, since the distribution of registry subjects in the population are unknown, this may be a representative sample.

Correlations were obtained between intelligence and different levels of BAQ for all devices tested. In order to determine the relation between intelligence and performance for each task in this phase of the study, subjects were first grouped into either a social or registry class. Responses were also divided into those given on Trials 1 and 7 (the control and reduced BAQ levels) and those given on Trial 4; the trial with the highest average BAQ level. A total of 40 correlation coefficients were obtained, of which 11 were significant ($p < 0.05$). None of the performance given by Registry subjects on any task was related to intelligence. Correlation coefficients for all subjects tested are given in Table 43.

Several notes should be made on these results:

- 1) Of the correlations calculated, only 20, or half, were independent of each other. When this is the case, it is expected that somewhat more than the usual number of spurious correlations will occur purely by chance. Therefore, the number of significant correlations obtained (11) should not be impressive in and of itself;
- 2) Nine of the 11 significant correlations obtained were negatively significant. It appears that there is an inverse relationship between performance and intelligence for social subjects. However, with the exception of the errors score

TABLE 43. CORRELATION COEFFICIENTS BETWEEN INTELLIGENCE AND PERFORMANCE FOR INDICATED SUBJECT GROUPS AND TRIALS.

(T = Trials)

	Comp. Track		Phystester		A. S. Dwan	
	T ₁ & 7	T ₄	T ₁ & 7	T ₄	T ₁ & 7	T ₄
Social	-0.40***	-0.11	0.17	0.32	-0.35***	-0.32
Registry	-0.28	-0.24	0.08	0.19	-	-
Control	0.03	-0.39	-*	-	0.30	-0.30

	DDE		Creare		Pursuit Track. (Percent Correct)	
	T ₁ & 7	T ₄	T ₁ & 7	T ₄	T ₁ & 7	T ₄
Social	-0.23	-0.13	0.09	0.47*	0.60***	0.29
Registry	-	-	-	-	-0.21	0.40
Control	-0.27	0.16	-	-	-	-

	Pursuit Track. (Time on Target)		QuickKey		Comp. Test (Number of Errors)	
	T ₁ & 7	T ₄	T ₁ & 7	T ₄	T ₁ & 7	T ₄
Social	-0.37**	-0.41*	-0.44*	-0.13	-0.51*	-0.53**
Registry	0.12	-0.08	-	-	-	-
Control	-	-	-	-	0.14	0.50

	Comp. Test (Same Side)		Comp. Test (Opposite Side)	
	T ₁ & 7	T ₄	T ₁ & 7	T ₄
Social	-0.48***	-0.24	-0.530***	-0.24
Registry	-	-	-	-
Control	-	-	-0.54	-0.41

*p < 0.05.

**p < 0.01.

***p < 0.005.

-Indicates either no subjects tested or too few for a meaningful correlation.

on the Comp. Test device, all other negative correlations were obtained for measures of time and the larger the time measure, the worse the performance. Therefore, even though these correlations show a negative relationship, they should be interpreted as "the higher the intelligence score, the faster the performance";

- 3) Performance by registry subjects was not related to intelligence on any task; and
- 4) There was no significant relation between intelligence and performance on either the DDE or the Phystester devices.

4.3 Phase III--Analysis of Results

The devices chosen for testing in the final phase of this project were the Complex Reaction Tester, Compensatory Tracking, Phystester, and QuicKey. A total of 13 male and 7 female subjects were tested but 1 female subject was dropped early in the test period after becoming ill. Further, only 2 of the 20 subjects tested were registry subjects. With so few registry subjects it was not possible to make a comparison between social and registry subjects during Phase III.

This phase differed from Phase II in several ways. Subjects were tested with alcohol on each of 3 days. With the exception of QuicKey the testing procedure on each of the 3 days was as follows: subjects were tested at blood alcohol 7 levels similar to the levels in Phase II. Within each level 3 repetitions were given with 3 trials in each repetition. A pass-fail criterion was established for each subject and each time the stimulus was presented a record was made of whether or not the subject passed. Therefore on each of the 3 repetitions at a given blood alcohol level, a subject could have scored 0, 1, 2, or 3 passes. The QuicKey device differed from this procedure in that the subject was given 2 minutes in order to pass at each blood alcohol level, with as many attempts at passing as possible within the 2 minute interval. (Testing was stopped when the subject passed or when the 2 minutes was over and subject failed.) Therefore the dependent measure on QuicKey was either "pass" or "fail" at each alcohol exposure level (Trials 1-7).

In Appendix B, Table IX presents the BAQ levels for each of the 19 subjects and the number correct on each test trial for each device. Figures 21-24 show the relation between test trials and performance on each device for the 2 registry and 17 social subjects tested.

QUICKEY

17 SOCIAL AND 2 REGISTRY SUBJECTS

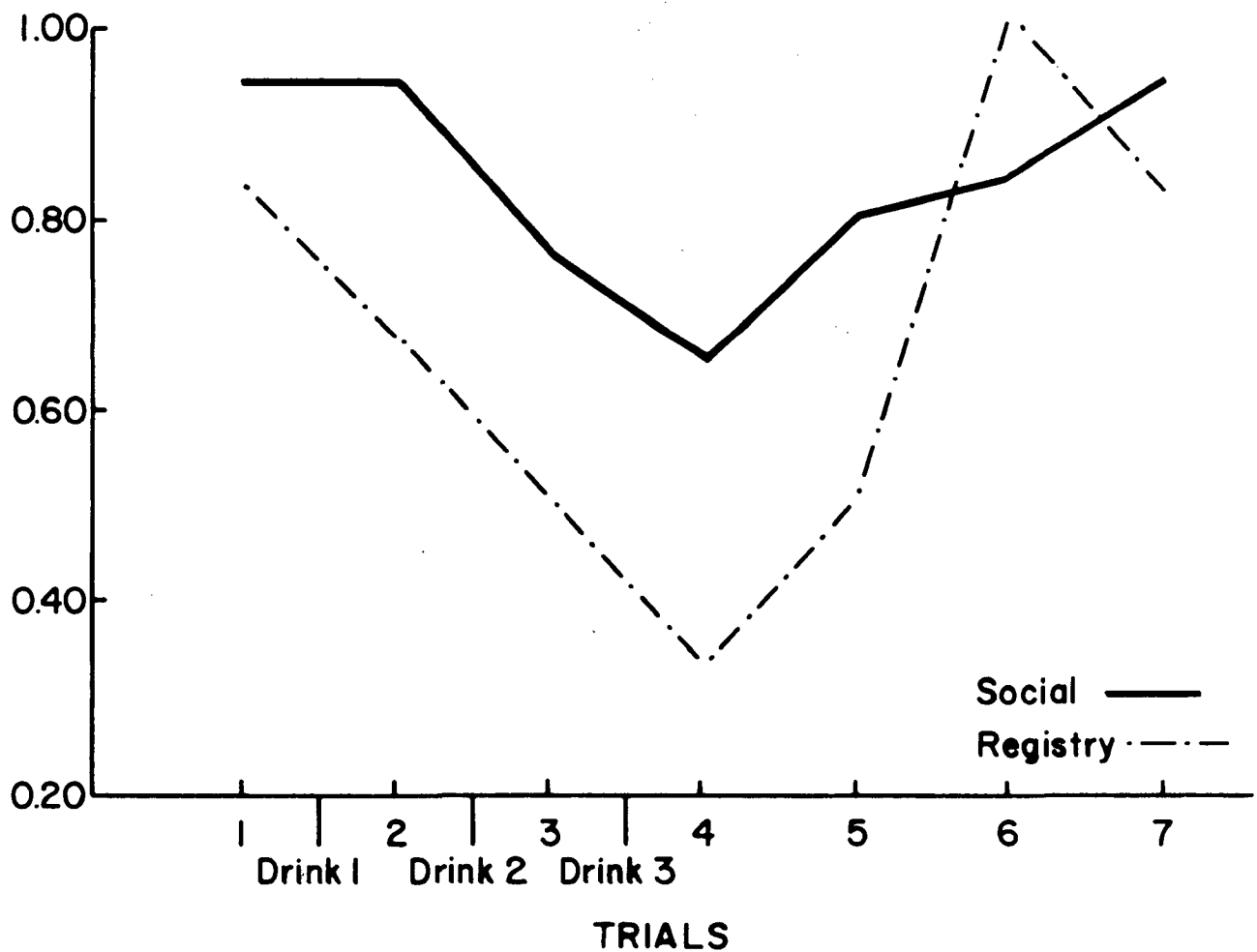


Figure 21. Relation between proportion of passing scores and test trials on the QuicKey device for 2 registry and 17 social subjects

PHYSTESTER

17 SOCIAL AND 2 REGISTRY SUBJECTS

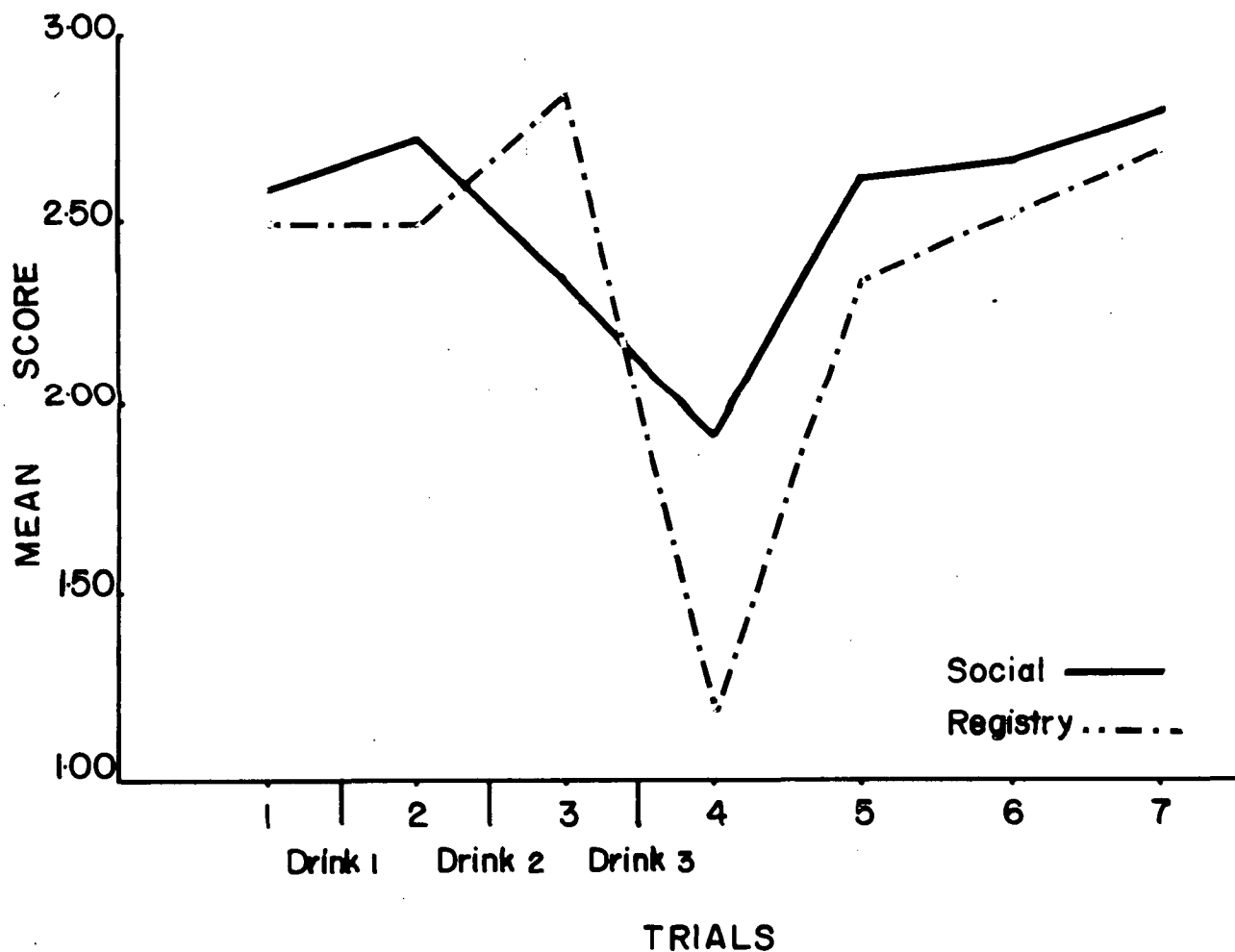


Figure 22. Relation between number of passing scores and test trials on the Phystester device for 2 registry and 17 social subjects.

COMPENSATORY TRACKING

17 SOCIAL AND 2 REGISTRY SUBJECTS

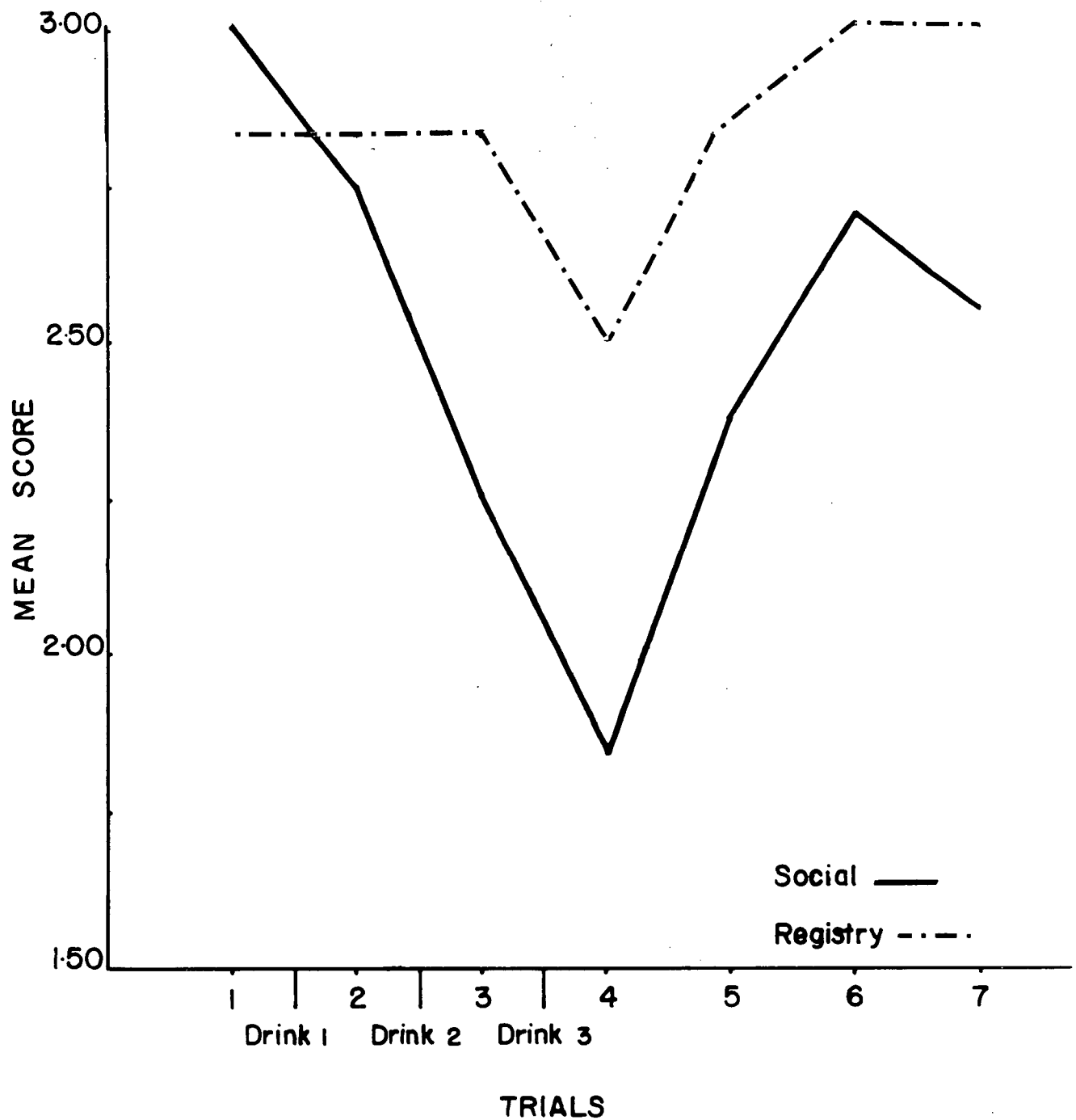


Figure 23. Relation between number of passing scores and test trials on the Compensatory Tracking device for 2 registry and 17 social subjects.

COMP TEST

17 SOCIAL AND 2 REGISTRY SUBJECTS

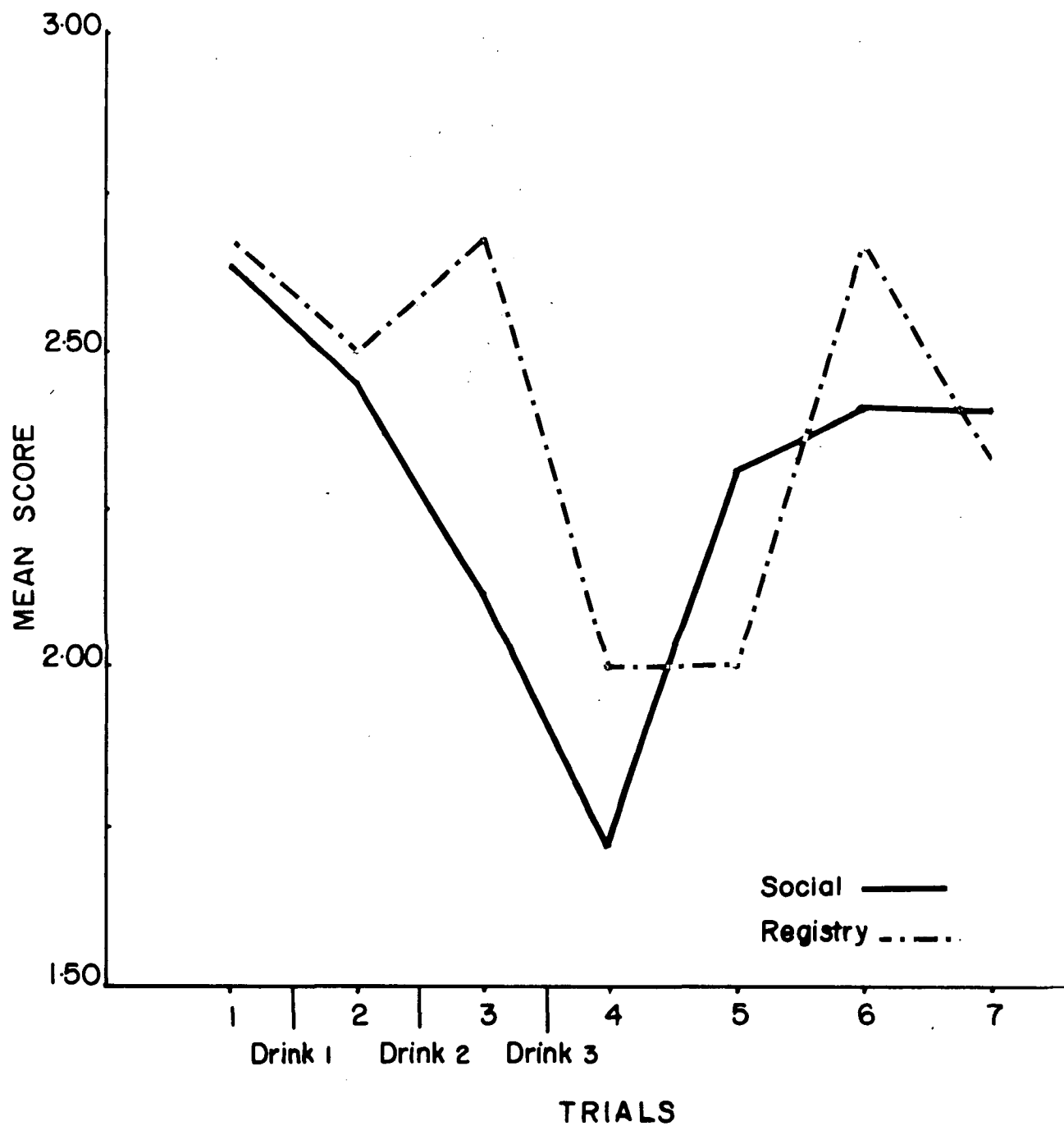


Figure 24. Relation between number of passing scores and test trials on the Comp. Test device for 2 registry and 17 social subjects.

Each graph shows that performance was inversely related to the BAQ level. That is, as levels increased reaching a mean maximum on Trial 4, performance decreased, and as the levels decreased (Trials 5-7) performance increased.* A summary of the mean number of passes obtained by the registry and social subjects on each device is presented in Table 44.

TABLE 44. RELATION BETWEEN MEAN BAQ LEVELS AND MEAN NUMBER OF PASSES FOR 17 SOCIAL AND 2 REGISTRY SUBJECTS ON EACH TRIAL TESTED.

2 Registry Subjects					
<u>Trial</u>	<u>BAQ</u>	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>	<u>QuicKey</u>
1	0.000	2.83	2.67	2.50	0.83
2	0.048	2.83	2.50	2.50	0.67
3	0.098	2.83	2.67	2.83	0.50
4	0.147	2.50	2.00	1.17	0.33
5	0.097	2.83	2.00	2.33	0.50
6	0.081	3.00	2.67	2.50	1.00
7	0.061	3.00	2.33	2.67	0.83

17 Social Subjects					
<u>Trial</u>	<u>BAQ</u>	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>	<u>QuicKey</u>
1	0.007	3.00	2.63	2.59	0.94
2	0.039	2.74	2.45	2.72	0.94
3	0.075	2.25	2.12	2.35	0.76
4	0.094	1.84	1.72	1.92	0.65
5	0.065	2.37	2.31	2.61	0.80
6	0.050	2.70	2.41	2.65	0.84
7	0.033	2.55	2.41	2.78	0.94

*The pass-fail criteria used for each device is presented on pages 29-31 of this report.

Data for this phase of the project were analyzed in several ways. In one method data were used only from Trials 1, 4, and 7, corresponding to the control, zero alcohol level, the highest blood alcohol level, and the lowest level tested after drinking ended, respectively. Arbitrarily 3 criteria of passing on each repetition were used for scoring. They were:

- (1) "at least one correct response,"
- (2) "at least 2 correct responses," and
- (3) "3 correct responses."

Using each of these criteria, the percentage of failures for each of the 7 trials across the 3 test days is reported in Table 45. Since QuickKey was scored only on a pass-fail basis, these criteria for passing do not apply to this device.

It appears from these results that using "at least 2 correct" is a better criterion measure than using "at least 1 correct" because there is a greater percentage of failing a subject with an elevated blood alcohol level (compare the results in Trial 4) while still maintaining a low failure ratio on the reduced and zero levels. The "3 correct" criterion level also is not adequate because even though it fails more subjects with an elevated level (compare the results on Trial 4 between "at least 2 correct to pass" and "3 correct to pass") it also fails a large and unacceptable number of subjects with low or zero levels (Trials 1 and 7 of the "3 correct responses to pass" criterion). Therefore, concentrating attention at the "at least 2 correct" criterion, it appears that the QuickKey device was best of all those tested. While it failed 7.02% of subjects on Trials 1 and 7, it also failed 40.35% of the subjects who have the most elevated BAQ level (on Trial 4). Thus it discriminated 33.32% (40.35%-7.02%) of the drinking population. This was better than any of the other devices tested.

The number of failures by each subject on each device was calculated using "at least 2 correct responses" as the criterion measure. This was done to see if any subject consistently passed or failed all devices on Trials 1, 4, and 7, regardless of his blood alcohol level. No such cases were found, and the data are presented in Table X of Appendix B.

A comparison of mean performance was made on all devices for subjects at a BAQ level of approximately 0.05 at two points in time: while the blood level was increasing (Trial 2) and decreasing (Trials 6 and 7). No significant differences between any means were found. Since no significant differences were found between ascending and descending blood alcohol levels, 4 classes of BAQ levels were arbitrarily made. These were $\leq 0.03\%$, $0.03-0.06\%$, $0.061-0.09\%$, and $\geq 0.09\%$. The number of points represented in each grouping were 118, 119, 100, and 62 respectively. Using "at

TABLE 45. PERCENT OF FAILURES FOR EACH DEVICE ON THE INDICATED TRIALS AND CRITERIA USED FOR PASSING.

At Least 1 Correct Response to Pass

	<u>Trial 1</u>	<u>Trial 4</u>	<u>Trial 7</u>
Comp. Track.	0%	17.54	0
Comp. Test	1.75	14.04	3.51
Phystester	0	10.53	0
QuicKey*	7.02	40.35	7.02

At Least 2 Correct Responses to Pass

	<u>Trial 1</u>	<u>Trial 4</u>	<u>Trial 7</u>
Comp. Track.	3.51	29.82	3.51
Comp. Test	3.51	35.09	12.28
Phystester	1.75	29.82	0
QuicKey*	7.02	40.35	7.02

3 Correct Responses to Pass

	<u>Trial 1</u>	<u>Trial 4</u>	<u>Trial 7</u>
Comp. Track.	12.28	57.89	19.30
Comp. Test	31.58	68.42	42.10
Phystester	42.10	64.91	21.05
QuicKey*	7.02	40.35	7.02

*Since QuicKey was scored only on a pass-fail basis, the criteria of passage used for the other devices do not apply to the QuicKey.

least 2 correct responses" as criterion, the percentage of failures occurring in each of the 4 BAQ groups was calculated and presented in Table 46 and illustrated in Figure 25. From this figure it is evident that the QuicKey device discriminated the drinking subject best of all devices tested while permitting almost all subjects to pass with low and zero BAQ levels. It should be noted that while 7.02% of subjects failed the QuicKey device on Trial 1 (the Control Trial), only 4.24% of subjects failed in the BAQ category $\leq 0.03\%$. This is because only 57 points are represented on Trial 1 and 118 points in the $\leq 0.03\%$ BAQ category. While the absolute number of subjects who failed the task must increase above a control BAQ condition, the percent of failures did decrease.

TABLE 46. PERCENT OF FAILURES FOR 4 BAQ LEVELS FOR EACH DEVICE USING "AT LEAST 2 CORRECT RESPONSES TO PASS" AS CRITERION.

	Comp. <u>Track.</u>	Comp. <u>Test</u>	<u>Phystester</u>	<u>QuicKey*</u>
≤ 0.03	3.39	8.47	1.69	4.24
0.031-0.06	3.36	10.92	5.88	11.76
0.061-0.09	16.00	23.00	11.00	25.00
> 0.09	25.81	30.65	24.19	43.55

*Since QuicKey is scored on a pass-fail basis, the indicated criterion does not apply.

Two other methods of data analysis were used. One was to analyze only the first trial within each of the 3 repetitions given at each of the 7 BAQ levels. In effect this means that the data were analyzed as if each subject received only 1 trial at each repetition level and the criterion of passing naturally was that the subject passed that trial. Table 47 shows the percent of failures for each of the 4 arbitrarily derived BAQ levels using this method. Results are illustrated in Figure 26. Also the first 2-trials within each of the 3 repetitions was used as the basic datum and subjects were required to pass both trials to receive a passing score. These results are listed also in Table 47 and illustrated in Figure 27. These tables and graphs show that although a relatively large percent of failures occurred at BAQ levels $> 0.09\%$, a large percent of failures occurred at the low levels ($\leq 0.03\%$). The raw data for each subject is presented in Appendix B, Table XI.

The mean performance of each device was compared across days

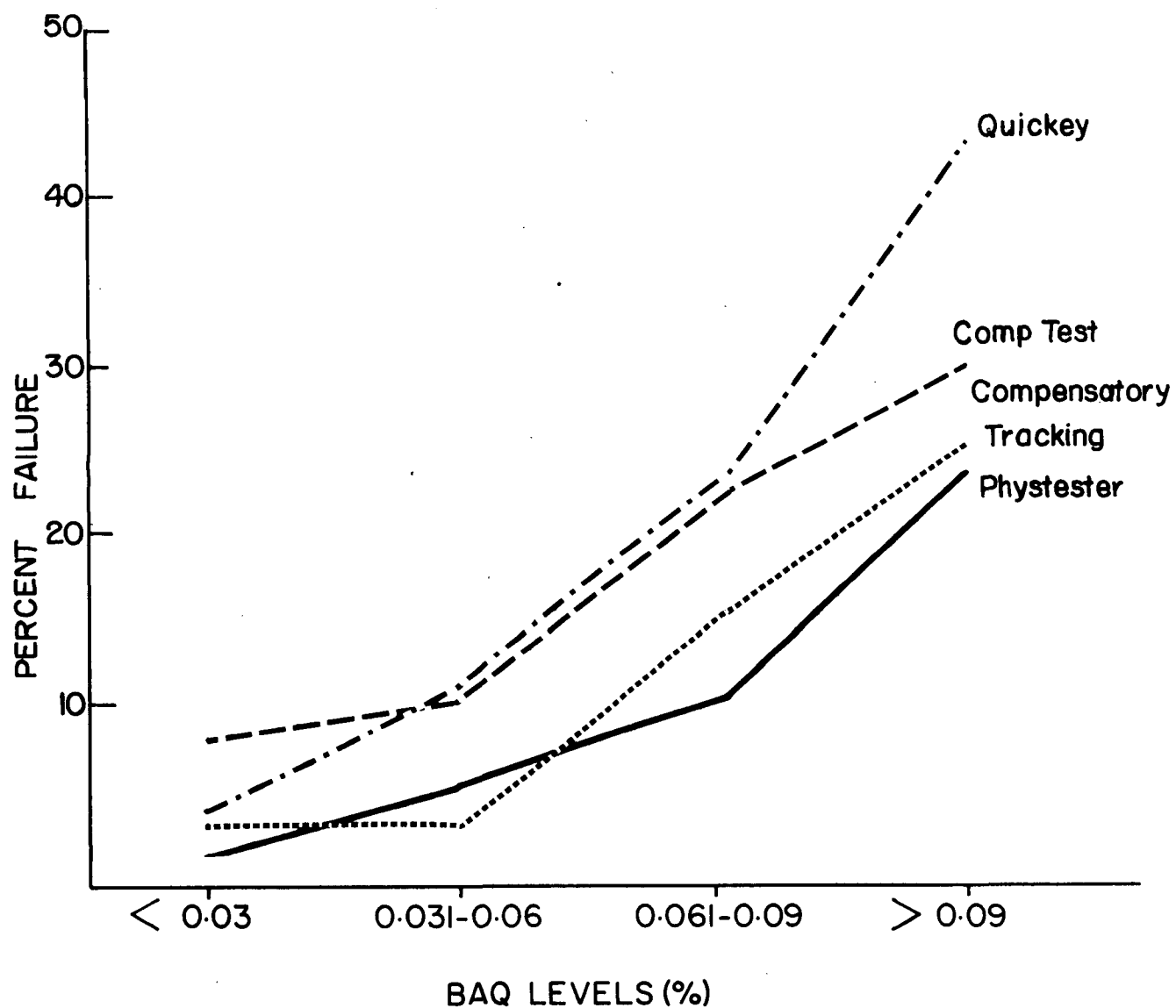


Figure 25. Relation between BAQ and percent failure on each device using "at least 2 correct responses" as the criterion for passing.

TABLE 47. PERCENT OF FAILURES FOR 4 BAQ LEVELS ON 3 DEVICES
USING THE FIRST TRIAL AND FIRST 2-TRIALS AS THE
BASIC DATUM AND REQUIRING ALL TRIALS TO BE PASSED.

Date 1/1/72 Percent Failures

	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>
≤ 0.03	12.71	14.41	11.02
0.031-0.06	20.17	21.01	11.76
0.061-0.09	30.00	30.00	18.00
> 0.09	45.16	35.48	37.10

Date 2/2/72 Percent Failures

	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>
≤ 0.03	12.71	26.27	21.19
0.031-0.06	21.85	36.13	20.17
0.061-0.09	37.00	43.00	30.00
> 0.09	51.61	48.39	40.32

for each device. The variance for each day did not differ for any device. Both the Phystester and QuicKey devices did not show any significant difference as a function of the 3 test days. However, the mean performance of Comp. Track. and Comp. Test did improve over days with performance being best on the 3rd test day ($p < 0.025$). This suggests that the subjects still continued to improve on these two devices despite their extensive training periods.

A point biserial coefficient of correlation was computed to determine the relationship between intelligence and performance. The computed coefficients were all extremely small and none was significantly different from zero (Table 48). This may have resulted from having a relatively small sample of subjects whose intelligence level was significantly above the population mean (81.37 percentile). Percentile scores for intelligence for each subject tested in Phase III are given in Appendix B, Table XII.

Eight subjects were tested under 2 control conditions, while 4 other subjects were tested under 1 control state; each group receiving 7 trials per test condition. These subjects previously

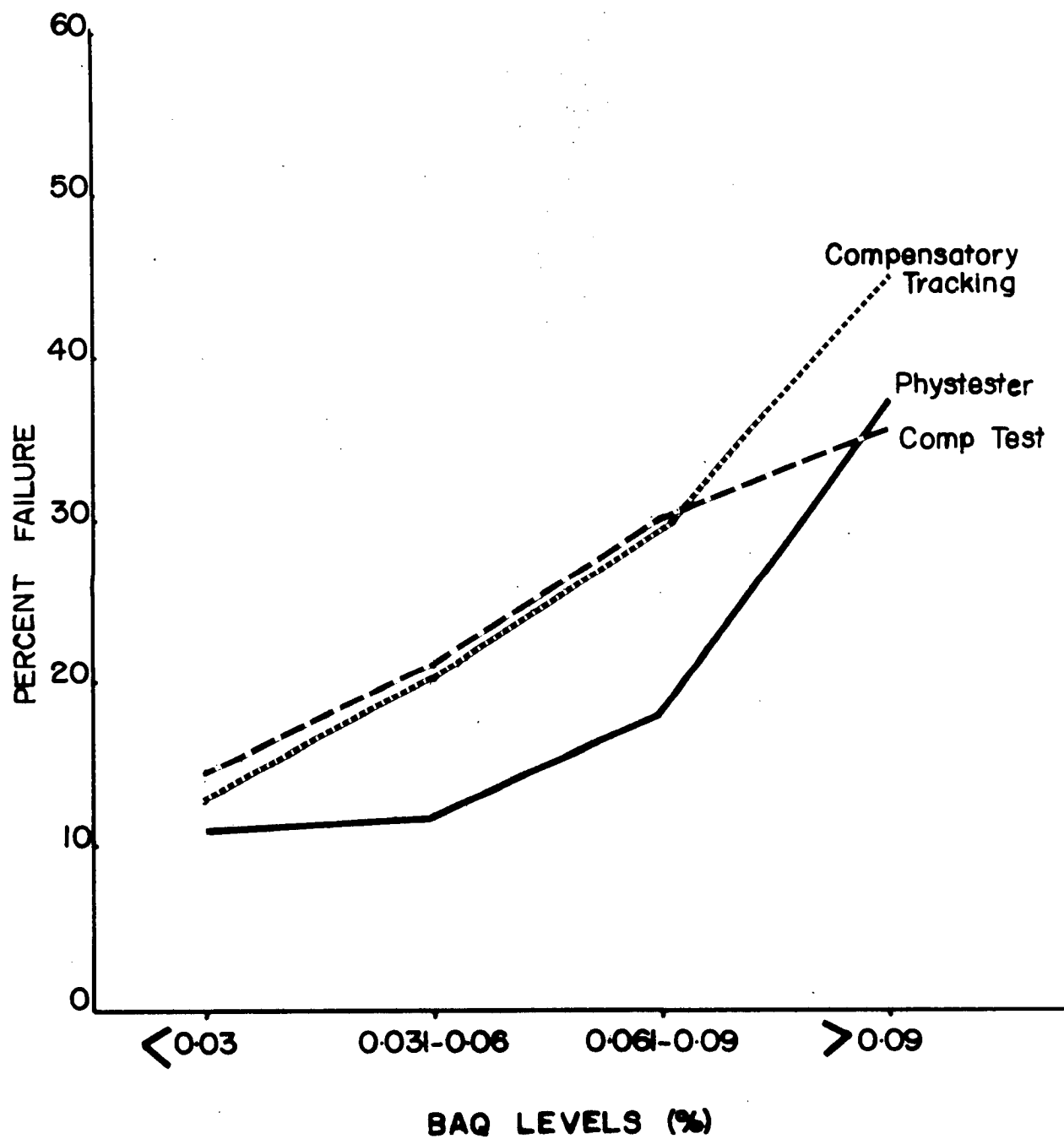


Figure 26. Relation between BAQ and percent failure on 3 devices using only the first trial in each repetition as the basic datum.

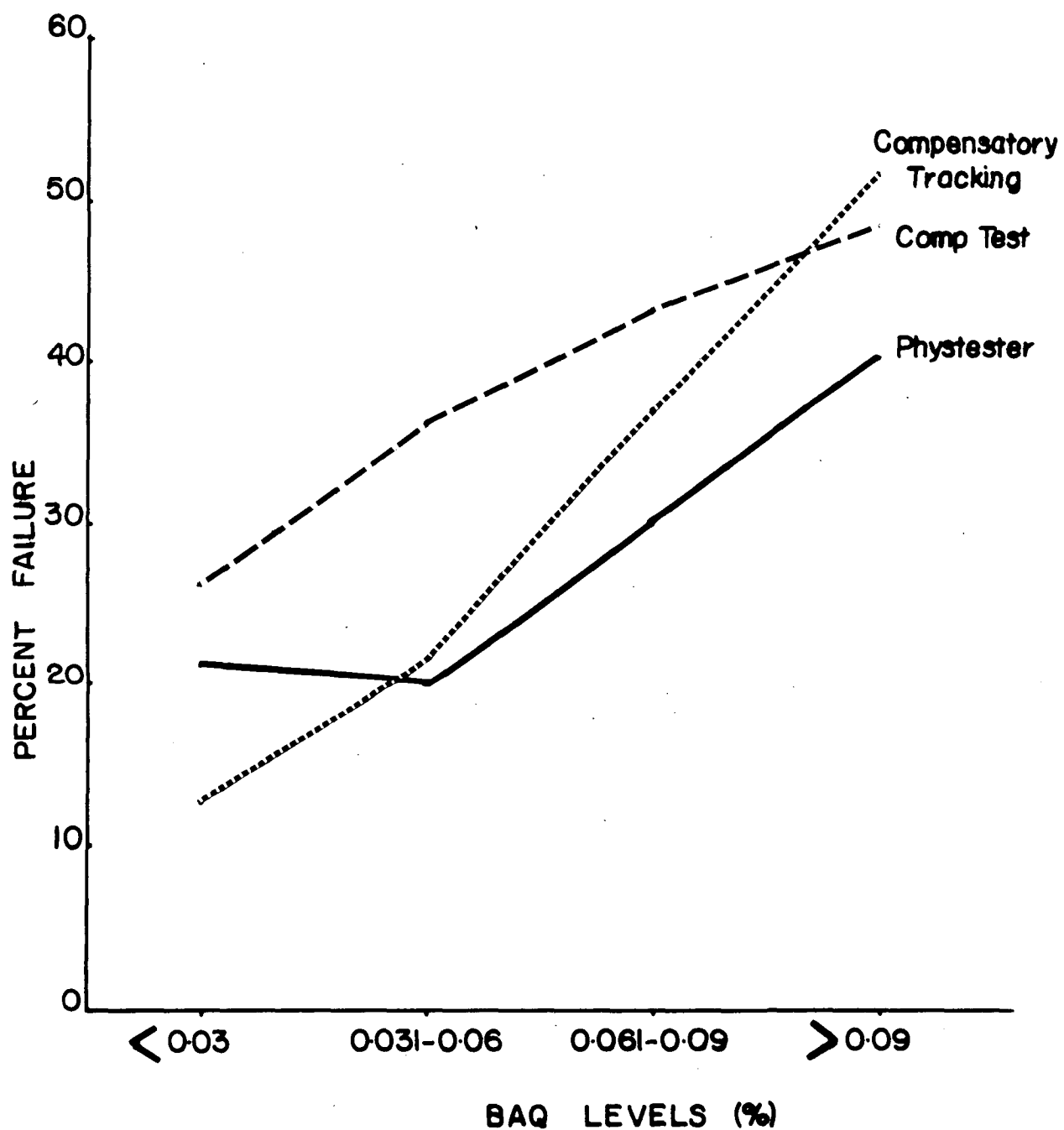


Figure 27. Relation between BAQ and percent failure on 3 devices using only the first 2 trials in each repetition as the basic datum and requiring both trials to be passed.

TABLE 48. CORRELATION COEFFICIENTS BETWEEN INTELLIGENCE AND PERFORMANCE ON EACH DEVICE FOR ALL SUBJECTS TESTED.

<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	<u>QuicKey</u>
0.069	0.019	0.001	0.026

served as experimental subjects in this phase of the study and thus were well trained. Analysis of their results showed that (1) there was no significant difference in mean performance over the 7 test trials for each device and, (2) when compared with their own results under the experimental condition, performance was significantly better on Trial 4 of the control days. This finding indicates that the effects of alcohol causes the decrement in performance at elevated BAQ levels as compared to a constant diurnal variation. Control subjects raw data are presented in Appendix B, Table XIII.

4.3.1 Discussion of the Results of Phase III

1. Thirteen male and 6 female subjects were tested on Comp. Track., Comp. Test, Phystester, and QuicKey devices in Phase III of this project. Only 2 of the 13 male subjects were supplied by the Registry, hence no comparisons between them and social subjects were made. Criteria for pass-fail were established and subjects tested for 3 days under 7 blood alcohol levels. In addition, 8 of the same, well trained subjects were tested for 7 trials on each of 2 control days on which no alcohol was given.

2. Performance for social subjects under elevated BAQ levels was significantly lower than under reduced or zero levels for all devices (Figs. 21-24). This decrement was due to the increased BAQ levels rather than to any diurnal variations.

3. For devices other than the QuicKey the best criterion to use for pass-fail was "at least 2 correct responses" because a low rate of failure occurs at reduced or zero BAQ levels, while at the same time, a relatively higher failure rate occurs in subjects with an elevated BAQ level (Table 38).

4. There were no mean differences in performance at similar increasing and decreasing BAQ levels, i.e., while subjects are drinking and after they have stopped drinking and absorbing alcohol.

5. Four BAQ levels were arbitrarily chosen: $\leq 0.03\%$, $0.03\%-0.06\%$, $0.061-0.09\%$, and >0.09 . Using "at least 2 correct responses" to pass, subjects failed more frequently on the QuickKey device than on the other 3 devices at BAQ levels >0.09 . At reduced BAQ levels ($\leq 0.03\%$) the failure rate for QuickKey was small (4.24%--Table 39).

6. When the first trial and first 2 trials of each repetition was used as the basic datum and subjects were required to pass all trials data showed a higher failure rate on each device for low levels ($\leq 0.03\%$ --Table 40).

7. Regardless of the BAQ level, no significant relation existed on any device between intelligence and performance.

8. Mean performance continued to improve significantly over the 3 test days only for the Comp. Track. and Comp. Test devices ($p < 0.025$). However, the variance within each day for each device was not significantly different from each other.

4.4 Subjects' Drinking Patterns

No methods were available during Phase I for sampling the drinking patterns of the subjects. During Phase II a questionnaire was obtained which gave some historical information about the subject's health and considerable data about drinking patterns and the association between drinking and the subject's social adjustment and also of the role alcohol played in this adjustment. However this instrument was not designed for easy coding for automatic data reduction systems. By the end of Phase II the questionnaire had been redesigned so that a key punch operator could read and simultaneously punch the subject's responses onto a card. About half of the subjects in Phase II and all subjects in Phase III completed the questionnaire. A recapitulation of more informative responses is given in Table XIV in Appendix B. A total of 13 registry and 34 social drinkers were surveyed with this instrument.

The questionnaire supported the validity of our screening process. No subjects were included who subsequently reported a history of serious medical disorder, emotional illness or drug dependence. (One Subject used sleeping pills but not during this study.)

Driving histories of the social drinkers revealed no social conflicts. None had been arrested while driving. Of course, 100% of the 13 registry subjects had at least one arrest for driving under the influence of alcohol.

The questionnaire also provided information with regard to arrest for other offenses. Again, the registry subjects had the

poorer record; 6 of 13 registry subjects reported such an arrest, whereas only 9 of 33 social drinkers made this admission.

Most subjects had begun drinking at the age of 18 with a mode for total years exposure of 8 for registry subjects and 5 for social drinkers. The registry subjects drank more frequently and, in their opinion, to higher alcohol levels than the average social drinker. The most frequently used beverage was beer, but the registry subjects were more likely to use distilled alcohol than the social drinkers. Most subjects drank at home or at parties.

Subjects gave a variety of reasons for drinking, with a surprising number (40% social and 60% registry) citing increased self confidence and courage as a reason. Most registry subjects felt that drinking had become a problem in their lives; a small fraction of social drinkers made this admission.

A high proportion (72%) of the total population was unemployed. This variable is associated with problem drinking but in our population it was seen in both registry and social drinkers. In this population of social drinkers it probably represented the large number of students and the high rate of unemployment in that group.

Of those subjects who regarded themselves as problem drinkers, only 15% (2 out of 14) had sought treatment for this difficulty. Data were not sufficient to determine the reason that such a small proportion of the problem drinkers had sought help.

Cooperation from the subjects in completing the questionnaire appeared to be good. Whereas a number of subjects questioned us to determine the reasons for asking such probing questions, no subjects refused to complete the questionnaire, questioned its value, or suggested that they were forced in any way to furnish unnecessarily personal data.

APPENDIX A

TABLE I. MEAN PERFORMANCE SCORE FOR 1 MALE AND 1 FEMALE REGISTRY SUBJECTS ON THE CREARE DEVICE.

<u>Trial</u>	<u>BAQ</u>	<u>Hz.</u>
1	0.021	53.08
2	0.045	53.02
3	0.078	51.60
4	0.148	52.02
5	0.112	51.99
6	0.088	52.82
7	0.065	53.24

TABLE II. MEAN PERFORMANCE SCORE FOR 1 MALE AND 1 FEMALE SOCIAL CONTROL SUBJECTS (NO ALCOHOL GIVEN DURING THE TEST PERIODS) ON THE CREARE DEVICE.

<u>Trial</u>	<u>Hz.</u>
1	50.59
2	50.25
3	52.09
4	51.75
5	52.09
6	51.25
7	51.92

TABLE III. SUMMARY OF ANALYSIS OF VARIANCE FOR 18 MALE SOCIAL SUBJECTS TESTED ON THE DDE DEVICE.

<u>Sources of Variance</u>	<u>degrees of freedom</u>	<u>Sums of Squares</u>	<u>Mean Squares</u>
Total	1994	384,802,816.0	192,980.28
Repetitions (R)	14	2,045,984.0	146,141.69
Trials (T)	6	2,690,640.0	448,439.94
Subjects (S)	18	26,581,856.0	1,476,769.50
R x T	84	12,492,976.0	148,725.88
R x S	252	35,037,776.0	139,038.78
T x S	108	76,337,504.0	706,828.50
R x T x S	1512	229,616,032.0	151,862.41

TABLE IV. SUMMARY OF ANALYSIS OF VARIANCE FOR 6 FEMALE SOCIAL SUBJECTS
TESTED ON THE DDE DEVICE.

<u>Sources of Variance</u>	<u>degrees of freedom</u>	<u>Sums of Squares</u>	<u>Mean Squares</u>
Total	629	396,942,080.0	631,068.38
Repetitions (R)	14	5,980,032.0	427,145.06
Trials (T)	6	14,516,836.0	2,419,472.50
Subjects (S)	5	22,495,708.0	4,499,141.00
R x T	84	38,441,136.0	457,632.50
R x S	70	28,559,636.0	407,994.75
T x S	30	68,176,864.0	2,272,561.50
R x T x S	420	218,771,744.0	520,885.06

TABLE V. SUMMARY OF ANALYSIS OF VARIANCE FOR 5 MALE CONTROL SUBJECTS
TESTED ON THE DDE DEVICE.

<u>Sources of Variance</u>	<u>degrees of freedom</u>	<u>Sums of Squares</u>	<u>Mean Squares</u>
Total	419	226,919,680.0	541,574.38
Repetitions (R)	14	7,027,302.0	501,950.06
Trials (T)	6	1,419,814.0	236,635.63
Subjects (S)	3	7,135,086.0	2,378,361.50
R x T	84	54,918,736.0	653,794.38
R x S	42	20,562,568.0	489,584.88
T x S	18	10,104,056.0	561,336.38
R x T x S	252	125,752,128.0	499,016.31

TABLE VI. SUMMARY OF ANALYSIS OF VARIANCE FOR 6 FEMALE SOCIAL SUBJECTS TESTED ON THE A. S. DWAN DEVICE.

<u>Sources of Variance</u>	<u>degrees of freedom</u>	<u>Sums of Squares</u>	<u>Mean Squares</u>	<u>F ratio</u>
Total	209	2,095,900.50	10,038.23	
Repetitions (R)	4	16,476.75	4,119.19	1.31
Trials (T)	6	137,428.00	22,904.66	1.04
Subjects (S)	5	196,173.12	39,234.62	
R x T	24	127,271.25	5,302.97	
R x S	20	62,789.00	3,139.45	
T x S	30	663,348.50	22,111.61	
R x T x S	120	892,413.87	7,436.78	

TABLE VII. MEAN PERFORMANCE SCORE FOR 1 FEMALE REGISTRY SUBJECT TESTED ON THE A. S. DWAN DEVICE.

<u>Trial</u>	<u>BAQ</u>	<u>Mean Score (Seconds)</u>
1	0.025	9.5
2	0.06	10.3
3	0.065	8.0
4	0.155	10.9
5	0.115	9.3
6	0.075	13.2
7	0.05	13.0

TABLE VIII. TOTAL RESPONSE TIME AND MEAN ERRORS FOR 3 CONTROL SUBJECTS TESTED ON THE COMP. TEST DEVICE.

<u>Trial</u>	<u>Same Side Reaction Time (R.T.)</u>	<u>Opposite Side Reaction Time (R.T.)</u>	<u>Mean Errors</u>
1	282.00	277.67	0.67
2	270.00	261.67	0.40
3	245.33	246.33	0.60
4	266.33	279.00	1.20
5	267.00	270.00	1.00
6	248.00	258.67	0.60
7	261.67	261.67	0.80

TABLE IX. TOTAL RESPONSE TIME AND MEAN ERRORS FOR 1 REGISTRY FEMALE
SUBJECT TESTED ON THE COMP. TEST DEVICE.

<u>Trial</u>	<u>Same Side Reaction Time</u>	<u>Opposite Side Reaction Time</u>	<u>Mean Errors</u>
1	272.6	315.8	1.0
2	280.6	315.8	1.0
3	252.8	292.4	0.2
4	304.4	341.6	1.4
5	288.0	319.2	1.0
6	293.2	316.4	1.0
7	257.4	325.4	0.2

TABLE X. SUMMARY OF ANALYSIS OF VARIANCE FOR 5 FEMALE SOCIAL SUBJECTS
TESTED ON THE SAME REACTION TIME MEASURE ON THE COMP. TEST DEVICE.

<u>Sources of Variance</u>	<u>degrees of freedom</u>	<u>Sums of Square</u>	<u>Mean Square</u>
Total	174	207,738.0	1,193.90
Repetitions (R)	4	1,579.0	392.50
Trials (T)	6	10,396.0	1,732.67
Subjects (S)	4	95,592.0	23,898.00
R x T	24	14,926.0	621.92
R x S	16	5,578.0	348.62
T x S	24	21,472.0	894.67
R x T x S	96	58,204.0	696.29

TABLE XI. SUMMARY OF ANALYSIS OF VARIANCE FOR 5 FEMALE SOCIAL SUBJECTS
TESTED ON THE NUMBER OF ERRORS MADE ON THE COMP. TEST DEVICE.

<u>Sources of Variance</u>	<u>degrees of freedom</u>	<u>Sums of Squares</u>	<u>Mean Squares</u>
Total	174	96.49	0.56
Repetitions (R)	4	1.85	0.46
Trials (T)	6	5.14	0.86
Subjects (S)	4	10.27	2.57
R x T	24	9.65	0.40
R x S	16	8.07	0.50
T x S	24	11.08	0.46
R x T x S	96	50.43	0.52

APPENDIX B

TABLE I. AGES OF SUBJECTS IN PHASE I.

	<u>Male Registry</u>	<u>Female Registry</u>	<u>Male Social</u>	<u>Female Social</u>	<u>Male</u>	<u>Female</u>	<u>Totals*</u>
	28	47	21(3)**	25	21(3)	25	21(3)
	29		22(2)	26	22(2)	26	22(2)
	31		23	55	23	47	23
	38		24(4)	62	24(4)	55	24(4)
	53		26		26	62	25
			42		28		26(2)
			54		29		28
			70		31		29
					38		31
					53		38
					42		42
					54		47
					70		53
							54
							55
							62
							70
Mean:	36	47	30	42	31	43	34
Range:	(28-53)	-	(21-70)	(25-62)	(21-70)	(25-62)	(21-70)

* The ages of 7 subjects were not available.

** Frequency of subjects if more than one for that age.

TABLE II. AGES OF SUBJECTS IN PHASE II.

<u>Male Registry</u>	<u>Female Registry</u>	<u>Male Social</u>	<u>Female Social</u>	<u>Male</u>	<u>Female</u>	<u>Totals</u>
21	47	21(3)*	21	21(4)	21	21(5)
22	58	22	22	22(2)	22	22(3)
23		23(2)	23	23(3)	23	23(4)
25		24(2)	24	24(2)	24	24(3)
27(2)		25(2)	26(2)	25(3)	26(2)	25(3)
28		26	27	26	27	26(3)
32(2)		27	48	27(3)	47	27(4)
36		28(2)	50	28(3)	48	28(3)
43		29		29	50	29
53		30		30	58	30
62		31(3)		31(3)		31(3)
		37(2)		32(2)		32(2)
		42(2)		36		36
		50		37(2)		37(2)
				42(2)		42(2)
				43		43
				50		47
				53		48
				62		50(2)
						53
						58
						62
Mean:	33	29	30	30	34	31
Range:	(21-62)	(21-50)	(21-50)	(21-62)	(21-58)	(21-62)

*Frequency of subjects if more than one for that age.

TABLE III. BLOOD ALCOHOL LEVELS (BAQs) REACHED FOR SUBJECTS WHOSE FIRST DRINK* WAS CALCULATED FROM THE WIDMARK FORMULA.

Subjects' BAQs Reached Using
the Widmark Formula

	.035%
	.03
	.025
	.03
	.05
	.02
	.025
	.035
	.03
	.03
	.04
	.04
	.035
	.045
	.035
	.04
	.035
	.03
	.045
	.03
	.04
	.01
	.02
	.02
	.04
	.025
	.02
	.035
	.025
	.02
	.02
	.035
	.04
	.05
	.03
	.045
	.03
	.04
	.04
	.03
	.035
	.03
	.04
	.025
Mean:	.033
Mode:	.03
Range:	.01-.05

*The target blood alcohol level was .05%.

TABLE IV. AGES OF SUBJECTS IN PHASE III.

	<u>Male Registry</u>	<u>Female Registry</u>	<u>Male Social</u>	<u>Female Social</u>	<u>Male</u>	<u>Female</u>	<u>Total</u>
	23		21(2)*	21	21(2)	21	21(3)
	27		23(2)	22(2)	23(3)	22(2)	22(2)
			24	23	24	23	23(4)
			25	26(2)	25	26(2)	25
			28(2)		27		26(2)
					28(2)		27
							28(2)
Mean:	<u>25</u>		<u>24</u>	<u>23</u>	<u>24</u>	<u>23</u>	<u>24</u>
Range:	(23-27)		(21-28)	(21-26)	(21-28)	(21-26)	(21-28)

*Frequency of subjects if more than one for that age.

TABLE V. BLOOD ALCOHOL LEVELS (BAQs) REACHED FOR SUBJECTS WHOSE FIRST DRINK* WAS CALCULATED FROM THE CORRECTION STANDARD.

Subjects' BAQs Reached Using
the Correction Standard

.045%
.02
.055
.04
.05
.015
.04
.065
.04
.045
.06
.04
.05
.05
.05
.065
.055
.055
.09
.07
.05
.05
.035
.05
.02
.02
.04
.03
.03
.045
.03
.03
.04
.04
.045
.065
.045
.025
.04
.02
.03
.03

TABLE V--Continued

Subjects' BAQs Reached Using
the Correction Standard

	.055%
	.04
	.04
	.06
	.035
	.06
	.03
	.035
	.05
	.055
Mean:	.044
Mode:	.04
Range:	.015--.09

*The target blood alcohol level was .05%.

TABLE VI. A COMPARISON OF BLOOD ALCOHOL LEVELS (BAQs) REACHED WHEN THE FIRST DRINK* WAS CALCULATED FROM THE WIDMARK FORMULA AND THE CORRECTION STANDARD FOR THE SAME SUBJECTS.

	<u>BAQs Reached Using the Widmark Formula</u>	<u>BAQs Reached Using the Correction Standard</u>
S ₁	.035%	.045%
	.03	.02
S ₂	.025	.04
		.05
		.015
S ₃	.03	.04
		.065
		.04
S ₄	.05	.045
		.06
		.04
S ₅	.02	.05
		.05
		.05

*The target blood alcohol level was .05%.

TABLE VII. RATIO OF CONCENTRATION OF ALCOHOL TO BODY WEIGHT FOR
SUBJECTS TESTED ON THE QUICKEY DEVICE IN PHASE II.

<u>Subject</u>	<u>Concentration</u> <u>Body Weight</u>				<u>Concentration</u> <u>Body Weight</u> - 10 cc/hr.			
	T ₁	T ₂	T ₃	T ₄	T ₁	T ₂	T ₃	T ₄
1	0	0.26	0.59	0.83	0	0.26	0.51	0.40
2	0	0.27	0.62	0.86	0	0.27	0.52	0.43
3	0	0.26	0.55	0.76	0	0.26	0.48	0.47
4	0	0.26	0.52	0.68	0	0.26	0.45	0.42
5	0	0.27	0.56	0.80	0	0.27	0.47	0.42
6	0	0.26	0.53	0.66	0	0.26	0.46	0.37
7	0	0.26	0.55	0.79	0	0.26	0.48	0.51
8	0	0.19	0.41	0.51	0	0.19	0.32	0.19
9	0	0.27	0.53	0.80	0	0.27	0.45	0.58
10	0	0.26	0.63	0.94	0	0.26	0.53	0.69
11	0	0.26	0.63	0.82	0	0.26	0.51	0.48
12	0	0.27	0.61	0.75	0	0.27	0.51	0.47

TABLE VIII. PERCENTILE SCORES FOR DIFFERENT GROUPS OF SUBJECTS TESTED
IN PHASE II EITHER ON THE WESMAN PERSONNEL CLASSIFICATION
TEST OR THE PERSONNEL TESTS FOR INDUSTRY.

<u>Social Subjects</u>			
<u>Subject</u>	<u>Verbal</u>	<u>Numerical</u>	<u>Total</u>
1	99	80	*
2	99	96	*
3	93	99	97
4	99	34	96
5	88	99	95
6	99	60	95
7	95	82	95
8	99	81	83
9	94	70	*
10	94	53	90
11	97	46	90
12	84	95	89
13	80	96	88
14	71	99	87
15	76	90	87
16	93	52	87
17	85	77	*
18	85	72	*
19	67	99	84
20	74	95	84
21	93	43	83
22	82	58	*
23	65	99	79
24	88	43	75
25	78	61	72
26	88	34	71
27	64	63	67
28	58	34	62
29	64	43	56
30	70	34	56
31	76	26	56
32	55	86	*
33	63	41	54
34	42	52	43
35	58	34	43
36	52	39	42
37	21	41	28
38	42	13	21
39	18	23	18
40	28	13	15
41	13	34	15
42	8	29	13

TABLE VIII--Continued

Social Subjects

<u>Subject</u>	<u>Verbal</u>	<u>Numerical</u>	<u>Total</u>
43	42	3	12
44	20	1	6
45	3	1	1
46	2	4	1
47	1	1	1
48	1	1	1
Mean:	63.88	52.69	57.02

Control Subjects

<u>Subject</u>	<u>Verbal</u>	<u>Numerical</u>	<u>Total</u>
1	80	96	88
2	88	43	75
3	70	63	71
4	64	63	67
5	63	41	54
6	55	14	34
Mean:	70.00	53.33	64.83

Registry Subjects

<u>Subject</u>	<u>Verbal</u>	<u>Numerical</u>	<u>Total</u>
1	99	82	*
2	99	96	*
3	92	58	*
4	90	79	*
5	87	92	*
6	79	88	*
7	88	52	79
8	79	58	*
9	77	46	*
10	76	16	*
11	58	34	43
12	18	13	9
13	7	33	*
Mean :	73.00	57.46	-- *

*Subjects who took the Personnel Tests for Industry do not have a total score.

TABLE IX. NUMBER OF CORRECT RESPONSES AND BAQ LEVEL FOR EACH SUBJECT ON EACH DEVICE AND DAY TESTED.

Subject 1 - Registry - Male - Age 27 - Weight 222

Test Date 12/1/71

<u>Trial</u>	<u>BAQ</u>	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>	<u>QuicKey (Pass-Fail)</u>
1	0.00	3	3	2	P
2	0.04	2	3	3	P
3	0.11	2	3	3	F
4	0.145	2	2	2	P
5	0.10	2	2	3	P
6	0.08	3	3	3	P
7	0.065	3	2	3	P

Test Date 12/6/71

1	0.00	3	3	3	P
2	0.065	3	3	3	P
3	0.095	3	2	3	P
4	0.145	2	3	2	F
5	0.09	3	2	1	P
6	0.085	3	3	3	P
7	0.06	3	3	3	P

Test Date 12/9/71

1	0.00	3	3	3	F
2	0.04	3	3	3	F
3	0.11	3	3	2	F
4	0.15	3	3	2	F
5	0.08	3	2	3	F
6	0.065	3	3	3	P
7	0.05	3	2	3	F

TABLE IX--Continued

Subject 2 - Registry - Male - Age 23 - Weight 154

Test Date 12/1/71

<u>Trial</u>	<u>BAQ</u>	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>	<u>QuicKey (Pass-Fail)</u>
1	0.00	2	3	2	P
2	0.045	3	1	3	P
3	0.10	3	2	3	P
4	0.145	3	1	0	F
5	0.10	3	2	3	F
6	0.075	3	1	2	P
7	0.065	3	2	3	P

Test Date 12/6/71

1	0.00	3	2	2	P
2	0.06	3	2	1	F
3	0.085	3	3	3	F
4	0.135	3	2	1	F
5	0.09	3	2	3	P
6	0.08	3	3	2	P
7	0.065	3	3	3	P

Test Date 12/9/71

1	0.00	3	2	3	P
2	0.04	3	3	2	P
3	0.09	3	3	3	P
4	0.16	2	1	0	P
5	0.12	3	2	1	F
6	0.10	3	3	2	P
7	0.06	3	2	1	P

TABLE IX--Continued

Subject 3 - Social - Male - Age 21 - Weight 126

Test Date 12/1/71

<u>Trial</u>	<u>BAQ</u>	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>	<u>QuicKey (Pass-Fail)</u>
1	0.01	3	3	2	P
2	0.05	2	3	3	P
3	0.085	2	3	3	F
4	0.095	2	2	2	F
5	0.07	2	1	2	F
6	0.05	3	2	1	F
7	0.03	3	2	3	F

Test Date 12/6/71

1	0.00	3	3	3	P
2	0.02	3	2	3	P
3	0.08	3	1	3	P
4	0.12	2	0	1	F
5	0.085	3	3	3	F
6	0.06	3	2	3	F
7	0.05	3	1	3	P

Test Date 12/13/71

1	0.00	3	3	2	P
2	0.03	3	2	3	P
3	0.09	3	3	3	P
4	0.09	3	3	2	P
5	0.025	3	3	3	P
6	0.03	3	3	3	P
7	0.025	3	3	3	P

TABLE IX--Continued

Subject 4 - Social - Female - Age 26 - Weight 114

Test Date 12/1/71

<u>Trial</u>	<u>BAQ</u>	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>	<u>QuickKey (Pass-Fail)</u>
1	0.00	3	2	3	P
2	0.05	3	2	1	P
3	0.10	3	1	1	P
4	0.10	3	1	3	P
5	0.06	3	2	3	P
6	0.045	3	2	3	P
7	0.015	3	2	2	P

Test Date 12/6/71

1	0.00	3	3	3	P
2	0.045	3	2	3	P
3	0.105	2	3	3	P
4	0.09	3	2	2	P
5	0.06	3	2	2	P
6	0.045	3	2	2	P
7	0.03	3	3	2	P

Test Date 12/9/71

1	0.00	3	2	3	P
2	0.03	3	1	3	P
3	0.055	3	2	3	P
4	0.115	3	2	3	P
5	0.085	3	0	3	F
6	0.05	3	3	3	P
7	0.04	3	3	3	P

TABLE IX--Continued

Subject 5 - Social - Male - Age 23 - Weight 146

Test Date 12/8/71

<u>Trial</u>	<u>BAQ</u>	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>	<u>QuicKey</u>
1	0.00	3	3	3	P
2	0.035	3	2	3	P
3	0.08	2	1	2	F
4	0.11	0	0	0	F
5	0.085	3	1	0	F
6	0.075	3	2	2	P
7	0.04	3	2	3	P

Test Date 12/13/71

1	0.00	3	3	2	P
2	0.05	3	3	2	P
3	0.08	3	2	2	P
4	0.095	2	2	0	P
5	0.07	3	3	2	P
6	0.04	3	3	3	P
7	0.05	3	3	3	P

Test Date 12/17/71

1	0.00	3	3	2	P
2	0.055	3	2	2	P
3	0.065	3	2	2	F
4	0.11	3	3	1	F
5	0.06	3	2	3	F
6	0.055	2	3	3	F
7	0.05	3	3	3	F

TABLE IX--Continued

Subject 6 - Social - Female - Age 22 - Weight 151

Test Date 12/8/71

<u>Trial</u>	<u>BAQ</u>	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>	<u>QuicKey</u>
1	0.00	3	2	3	P
2	0.06	3	3	3	P
3	0.09	2	3	3	P
4	0.11	3	2	1	P
5	0.10	3	3	3	P
6	0.065	3	3	3	P
7	0.05	3	2	3	P

Test Date 12/13/71

1	0.00	3	3	3	P
2	0.02	3	3	3	P
3	0.065	3	3	2	F
4	0.10	3	3	1	P
5	0.075	3	2	3	P
6	0.04	3	2	3	P
7	0.035	3	2	2	P

Test Date 12/17/71

1	0.00	3	3	3	P
2	0.025	3	3	3	P
3	0.06	3	3	3	P
4	0.105	3	2	2	P
5	0.08	3	2	2	F
6	0.06	3	3	2	P
7	0.05	3	3	3	P

TABLE IX--Continued

Subject 7 - Social - Male - Age 28 - Weight 180

Test Date 12/8/71

<u>Trial</u>	<u>BAQ</u>	<u>Comp. Track.</u>	<u>Comp. Test.</u>	<u>Phystester</u>	<u>QuicKey</u>
1	0.00	3	2	2	P
2	0.035	2	1	3	F
3	0.10	2	2	3	F
4	0.065	3	0	3	P
5	0.035	3	3	2	P
6	0.02	3	2	3	P
7	0.01	3	2	3	P

Test Date 12/13/71

1	0.00	3	0	3	P
2	0.02	3	2	3	P
3	0.055	3	2	1	P
4	0.09	3	1	1	P
5	0.055	3	3	2	P
6	0.045	3	3	3	P
7	0.02	3	3	2	P

Test Date 12/17/71

1	0.00	3	2	2	P
2	0.01	3	2	3	P
3	0.035	3	2	2	P
4	0.06	3	0	2	P
5	0.04	3	2	3	P
6	0.02	3	1	2	P
7	0.01	3	0	2	P

TABLE IX--Continued

Subject 8 - Social - Male - Age 24 - Weight 162

Test Date 12/16/71

<u>Trial</u>	<u>BAQ</u>	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>	<u>QuicKey</u>
1	0.00	3	3	3	P
2	0.02	3	3	2	P
3	0.085	3	3	3	P
4	0.12	0	3	0	F
5	0.065	2	2	3	P
6	0.06	2	3	3	P
7	0.05	3	3	3	P

Test Date 12/20/71

1	0.00	3	3	3	P
2	0.025	3	3	2	P
3	0.06	3	3	3	P
4	0.115	1	2	3	P
5	0.09	2	3	3	P
6	0.05	3	3	3	P
7	0.02	3	3	3	P

Test Date 12/23/71

1	0.00	3	3	2	P
2	0.02	3	3	2	P
3	0.085	2	3	1	P
4	0.09	3	3	0	F
5	0.06	3	3	3	P
6	0.05	3	3	2	P
7	0.035	3	3	3	P

TABLE IX--Continued

Subject 9 - Social - Male - Age 28 - Weight 160

Test Date 12/16/71

<u>Trial</u>	<u>BAQ</u>	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>	<u>QuicKey</u>
1	0.00	1	3	1	P
2	0.03	2	2	3	P
3	0.10	3	2	3	P
4	0.12	2	2	2	P
5	0.06	2	1	3	P
6	0.055	2	2	3	P
7	0.035	2	3	3	P

Test Date 12/20/71

1	0.00	2	2	3	P
2	0.03	2	3	3	P
3	0.075	3	1	3	P
4	0.125	0	1	2	F
5	0.095	2	3	3	P
6	0.07	1	3	3	P
7	0.06	2	3	2	P

Test Date 12/23/71

1	0.00	3	3	3	P
2	0.055	2	3	2	P
3	0.07	3	3	2	P
4	0.12	2	3	3	P
5	0.085	2	3	3	P
6	0.07	2	3	3	P
7	0.035	3	3	3	P

TABLE IX--Continued

Subject 10 - Social - Male - Age 25 - Weight 127

Test Date 12/16/71

<u>Trial</u>	<u>BAQ</u>	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>	<u>QuicKey</u>
1	0.00	3	2	3	P
2	0.045	2	2	3	P
3	0.075	1	2	3	P
4	0.10	1	1	3	F
5	0.07	0	2	3	P
6	0.05	2	3	3	P
7	0.02	3	1	3	P

Test Date 12/20/71

1	0.00	1	3	3	P
2	0.02	2	3	3	P
3	0.095	0	1	3	P
4	0.110	0	0	3	P
5	0.07	0	2	3	P
6	0.05	2	2	2	P
7	0.03	1	1	3	P

Test Date 12/23/71

1	0.00	2	3	3	P
2	0.055	2	3	3	P
3	0.095	3	3	2	P
4	0.105	0	3	2	P
5	0.06	2	3	3	P
6	0.03	1	2	3	P
7	0.02	2	3	3	P

TABLE IX--Continued

Subject 11 - Social - Female - Age 26 - Weight 140

Test Date 12/16/71

<u>Trial</u>	<u>BAQ</u>	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>	<u>QuickKey</u>
1	0.00	3	2	3	P
2	0.04	3	1	2	P
3	0.09	2	2	2	P
4	0.13	3	3	2	F
5	0.08	2	3	3	P
6	0.07	3	2	2	P
7	0.035	2	2	3	P

Test Date 12/20/71

1	0.00	3	3	3	P
2	0.04	3	2	2	P
3	0.09	3	2	2	P
4	0.145	2	1	2	P
5	0.08	3	3	2	P
6	0.06	3	2	3	P
7	0.035	3	2	3	P

Test Date 12/23/71

1	0.00	3	3	3	P
2	0.06	3	3	3	P
3	0.08	3	2	2	F
4	0.105	3	2	2	F
5	0.07	3	3	1	F
6	0.05	3	3	3	P
7	0.02	3	3	2	P

TABLE IX--Continued

Subject 12 - Social - Female - Age 22 - Weight 130

Test Date 12/29/71

<u>Trial</u>	<u>BAQ</u>	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>	<u>QuicKey</u>
1	0.00	3	3	3	F
2	0.03	3	3	3	P
3	0.07	3	3	2	P
4	0.11	1	1	2	P
5	0.07	2	2	2	P
6	0.07	2	2	3	F
7	0.05	1	3	3	P

Test Date 1/3/72

1	0.00	3	3	2	P
2	0.03	3	3	3	P
3	0.08	1	3	3	P
4	0.095	0	1	2	P
5	0.055	2	3	3	P
6	0.05	2	3	3	P
7	0.025	3	3	3	P

Test Date 1/7/72

1	0.00	3	3	3	P
2	0.04	3	3	3	P
3	0.08	3	3	3	P
4	0.12	2	3	3	P
5	0.06	3	3	2	P
6	0.06	3	3	3	P
7	0.05	3	2	3	P

TABLE IX--Continued

Subject 13 - Social - Female - Age 21 - Weight 127

Test Date 12/29/71

<u>Trial</u>	<u>BAQ</u>	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>	<u>QuicKey</u>
1	0.00	3	3	2	P
2	0.04	3	3	3	P
3	0.065	0	2	1	P
4	0.09	1	1	2	P
5	0.08	3	3	3	P
6	0.05	3	1	3	P
7	0.04	3	2	2	P

Test Date 1/3/72

1	0.00	3	2	2	P
2	0.045	3	3	2	P
3	0.07	1	1	3	P
4	0.075	2	2	2	P
5	0.045	3	3	3	P
6	0.02	3	3	3	P
7	0.02	3	3	3	P

Test Date 1/7/72

1	0.00	3	2	3	P
2	0.065	3	2	3	P
3	0.065	3	3	2	P
4	0.06	3	3	3	P
5	0.035	2	3	3	P
6	0.02	3	3	2	P
7	0.005	3	2	3	P

TABLE IX--Continued

Subject 14 - Social - Male - Age 21 - Weight 161

Test Date 12/29/71

<u>Trial</u>	<u>BAQ</u>	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>	<u>QuicKey</u>
1	0.00	3	3	2	P
2	0.02	3	3	3	P
3	0.06	2	2	3	P
4	0.08	1	1	1	F
5	0.085	2	1	3	P
6	0.075	3	2	3	P
7	0.07	3	0	3	P

Test Date 1/3/72

1	0.00	3	3	3	P
2	0.02	2	2	3	P
3	0.035	3	3	2	P
4	0.04	3	2	3	P
5	0.02	3	2	2	P
6	0.01	3	2	3	P
7	0.00	3	3	3	P

Test Date 1/7/72

1	0.00	3	2	3	P
2	0.04	3	3	3	P
3	0.095	3	3	3	P
4	sick	0	0	0	F
5	0.04	3	2	3	P
6	0.04	3	3	2	P
7	0.015	3	3	3	P

TABLE IX--Continued

Subject 15 - Social - Male - Age 23 - Weight 151

Test Date 12/29/71

<u>Trial</u>	<u>BAQ</u>	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>	<u>QuicKey</u>
1	0.00	3	2	2	P
2	0.03	3	3	3	P
3	0.07	1	1	2	P
4	0.07	0	2	0	P
5	0.045	1	1	1	F
6	0.05	2	2	3	P
7	0.05	2	3	3	P

Test Date 1/3/72

1	0.00	3	3	2	P
2	0.03	3	3	2	P
3	0.04	1	2	1	P
4	0.045	1	2	3	P
5	0.045	2	1	3	P
6	0.015	3	1	3	P
7	0.00	3	1	2	P

Test Date 1/7/72

1	0.00	2	2	2	P
2	0.045	2	3	3	P
3	0.06	3	2	3	P
4	0.075	2	1	2	P
5	0.08	3	3	3	P
6	0.03	3	3	1	P
7	0.025	3	2	3	P

TABLE IX--Continued

Subject 16 - Social - Male - Age 31 - Weight 199

Test Date 1/11/72

<u>Trial</u>	<u>BAQ</u>	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>	<u>QuicKey</u>
1	0.01	2	1	3	P
2	0.08	3	2	2	P
3	0.095	0	1	2	P
4	0.11	1	0	2	F
5	0.075	0	0	3	P
6	0.055	2	1	2	F
7	0.04	2	2	3	P

Test Date 1/17/72

1	0.00	3	3	3	P
2	0.055	3	1	3	P
3	0.07	2	0	3	P
4	0.13	0	0	2	F
5	0.09	1	1	2	P
6	0.065	3	1	3	P
7	0.055	2	1	2	P

Test Date 1/21/72

1	0.00	3	2	3	P
2	0.055	2	1	2	P
3	0.085	2	1	3	P
4	0.09	1	0	2	P
5	0.065	3	2	2	P
6	0.075	3	2	2	P
7	0.03	3	2	3	P

TABLE IX--Continued

Subject 17 - Social - Male - Age 22 - Weight 149

Test Date 1/11/72

<u>Trial</u>	<u>BAQ</u>	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>	<u>QuicKey</u>
1	0.00	3	3	3	P
2	0.05	3	3	3	P
3	0.075	2	3	3	F
4	0.10	2	3	2	P
5	0.075	3	3	3	P
6	0.065	3	2	2	P
7	0.05	3	3	3	P

Test Date 1/17/72

1	0.00	3	3	2	P
2	0.035	3	3	3	P
3	0.065	1	2	3	P
4	0.115	0	2	3	P
5	0.10	1	3	3	P
6	0.095	3	3	3	P
7	0.055	3	3	3	P

Test Date 1/21/72

1	0.00	3	3	3	P
2	0.05	2	2	3	P
3	0.075	3	3	2	P
4	0.095	3	2	3	P
5	0.065	2	3	3	P
6	0.075	2	3	1	P
7	0.035	2	3	3	P

TABLE IX--Continued

Subject 18 - Social - Male - Age 22 - Weight 124

Test Date 1/11/72

<u>Trial</u>	<u>BAQ</u>	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>	<u>QuicKey</u>
1	0.00	3	3	2	F
2	0.045	3	3	3	P
3	0.09	2	2	2	F
4	0.115	2	2	2	F
5	0.06	2	3	3	F
6	0.06	3	2	3	F
7	0.05	3	3	2	P

Test Date 1/17/72

1	0.00	3	3	3	P
2	0.01	3	3	3	P
3	0.03	3	1	3	P
4	0.02	2	3	3	P
5	0.00	3	2	2	P
6	0.00	3	3	3	P
7	0.00	2	3	3	P

Test Date 1/21/72

1	0.00	3	3	3	P
2	0.01	3	2	3	P
3	0.03	2	2	3	P
4	0.04	3	3	3	P
5	0.02	3	3	3	P
6	0.01	3	3	3	P
7	0.00	3	3	3	P

TABLE IX--Continued

Subject 19 - Social - Female - Age 26 - Weight 202

Test Date 1/11/72

<u>Trial</u>	<u>BAQ</u>	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>	<u>QuicKey</u>
1	0.00	3	3	2	P
2	0.075	3	2	3	F
3	0.095	2	2	2	F
4	0.105	2	2	2	F
5	0.07	2	2	3	P
6	0.06	3	3	3	P
7	0.04	3	3	3	P

Test Date 1/18/72

1	0.00	3	3	2	F
2	0.07	2	3	3	F
3	0.10	2	1	0	F
4	0.11	3	2	2	F
5	0.075	2	3	3	F
6	0.07	3	2	3	F
7	0.055	3	3	3	F

Test Date 1/21/72

1	0.015	3	3	2	P
2	0.05	3	2	3	P
3	0.10	1	2	1	F
4	0.11	3	3	1	F
5	0.08	3	3	3	P
6	0.075	3	3	3	F
7	0.045	3	3	3	P

TABLE X. WITH A SCORE OF "AT LEAST 2 CORRECT RESPONSES" AS CRITERION,
DATA ARE THE TOTAL NUMBER OF FAILURES FOR THE 3 TEST DAYS
ON THE INDICATED DEVICE AND TRIAL FOR ALL SUBJECTS.

Subject	Comp. Test			Phystester			Comp. Track.			QuicKey		
	T ₁	T ₄	T ₇	T ₁	T ₄	T ₇	T ₁	T ₄	T ₇	T ₁	T ₄	T ₇
1	0	0	0	0	0	0	0	0	0	1	3	1
2	0	1	0	0	2	0	0	0	0	0	1	0
3	0	1	1	0	1	0	0	0	0	0	2	1
4	0	1	0	0	1	0	0	0	0	0	0	0
5	0	1	0	0	3	0	0	1	0	0	2	1
6	0	0	0	0	2	0	0	0	0	0	0	0
7	1	2	1	0	1	0	0	0	0	0	1	0
8	0	0	0	0	2	0	0	2	0	0	2	0
9	0	1	0	1	0	0	1	1	0	0	1	0
10	0	2	2	0	0	0	1	3	1	0	1	0
11	0	1	0	0	0	0	0	0	0	0	2	0
12	0	2	0	0	0	0	0	2	1	1	0	0
13	0	1	0	0	0	0	0	1	0	0	0	0
14	0	2	1	0	2	0	0	2	0	0	2	0
15	0	1	1	0	1	0	0	2	0	0	0	0
16	1	3	1	0	0	0	0	3	0	0	2	0
17	0	0	0	0	0	0	0	1	0	0	0	0
18	0	0	0	0	0	0	0	0	0	1	1	0
19	0	1	0	0	2	0	0	1	0	1	3	1

TABLE XI. THE PASS-FAIL SCORE ON THE FIRST TRIAL AND COMBINED FIRST AND SECOND TRIALS OF THE 3 TEST TRIALS IN EACH TEST SESSION FOR ALL SUBJECTS ON THE COMPENSATORY TRACKING, COMP. TEST AND PHYSTEster.

Subject 1 - Registry Male - Age 27 - Weight 222

Test Date 12/1/71

<u>Trial</u>	<u>BAQ</u>	<u>First Trial Pass</u>			<u>First 2 Trials Pass</u>		
		<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>
1	0.00	P	P	P	P	P	P
2	0.04	F	P	P	F	P	P
3	0.11	F	P	P	F	P	P
4	0.145	F	P	P	F	P	P
5	0.10	F	P	P	F	P	P
6	0.08	P	P	P	P	P	P
7	0.065	P	F	P	P	F	P

Test Date 12/6/71

1	0.00	P	P	P	P	P	P
2	0.065	P	P	P	P	P	P
3	0.095	P	P	P	P	F	P
4	0.145	F	P	F	F	P	F
5	0.09	P	P	F	P	P	F
6	0.085	P	P	P	P	P	P
7	0.06	P	P	P	P	P	P

Test Date 12/9/71

1	0.00	P	P	P	P	P	P
2	0.04	P	P	P	P	P	P
3	0.11	P	P	P	P	P	P
4	0.15	P	P	F	P	P	F
5	0.08	P	P	P	P	P	P
6	0.065	P	P	P	P	P	P
7	0.05	P	P	P	P	P	P

TABLE XI--Continued

Subject 2 - Registry - Male - Age 23 - Weight 154

Test Date 12/1/71First Trial PassFirst 2 Trials Pass

<u>Trial</u>	<u>BAQ</u>	<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>
1	0.00	F	P	P	F	P	P
2	0.045	P	F	P	P	F	P
3	0.10	P	F	P	P	F	P
4	0.145	P	P	F	P	F	F
5	0.10	P	P	P	P	P	P
6	0.075	P	F	P	P	F	F
7	0.065	P	P	P	P	F	P

Test Date 12/6/71

1	0.00	P	P	P	P	P	F
2	0.06	P	F	P	P	F	F
3	0.085	P	P	P	P	P	P
4	0.135	P	P	F	P	F	F
5	0.09	P	P	P	P	P	P
6	0.08	P	P	P	P	P	P
7	0.065	P	P	P	P	P	P

Test Date 12/9/71

1	0.00	P	F	P	P	F	P
2	0.04	P	P	P	P	P	P
3	0.09	P	P	P	P	P	P
4	0.16	F	F	F	F	F	F
5	0.12	P	F	F	P	F	F
6	0.10	P	P	P	P	P	F
7	0.06	P	F	P	P	F	F

TABLE XI--Continued

Subject 3 - Social - Male - Age 21 - Weight 126

Test Date 12/1/71

<u>First Trial Pass</u>					<u>First 2 Trials Pass</u>		
<u>Trial</u>	<u>BAQ</u>	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>
1	0.01	P	P	P	P	P	P
2	0.05	F	P	P	F	P	P
3	0.085	P	P	P	F	P	P
4	0.095	F	P	F	F	P	P
5	0.07	F	F	P	F	P	P
6	0.05	P	F	F	P	P	P
7	0.03	P	F	P	P	P	P

Test Date 12/6/71

1	0.00	P	P	P	P	P	P
2	0.02	P	F	P	P	F	P
3	0.08	P	F	P	P	F	P
4	0.12	F	F	P	F	F	F
5	0.085	P	P	P	P	P	P
6	0.06	P	P	P	P	F	P
7	0.05	P	F	P	P	F	P

Test Date 12/13/71

1	0.00	P	P	P	P	P	F
2	0.03	P	P	P	P	F	P
3	0.09	P	P	P	P	P	P
4	0.09	P	P	P	P	P	F
5	0.025	P	P	P	P	P	P
6	0.03	P	P	P	P	P	P
7	0.025	P	P	P	P	P	P

TABLE XI--Continued

Subject 4 - Social - Female - Age 26 - Weight 114

Test Date 12/1/71

<u>First Trial Pass</u>					<u>First 2 Trials Pass</u>		
<u>Trial</u>	<u>BAQ</u>	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>
1	0.00	P	P	P	P	F	P
2	0.05	P	F	F	P	F	F
3	0.10	P	P	F	P	F	F
4	0.10	P	P	P	P	F	P
5	0.06	P	P	P	P	P	P
6	0.045	P	P	P	P	F	P
7	0.015	P	P	F	P	P	F

Test Date 12/6/71

1	0.00	P	P	P	P	P	P
2	0.045	P	F	P	P	F	P
3	0.105	F	P	P	F	P	P
4	0.09	P	F	P	P	F	F
5	0.06	P	F	P	P	F	F
6	0.045	P	P	F	P	F	F
7	0.03	P	P	P	P	P	F

Test Date 12/9/71

1	0.00	P	P	P	P	F	P
2	0.03	P	P	P	P	F	P
3	0.055	P	F	P	P	F	P
4	0.115	P	P	P	P	P	P
5	0.085	P	F	P	P	F	P
6	0.05	P	P	P	P	P	P
7	0.04	P	P	P	P	P	P

TABLE XI--Continued

Subject 5 - Social - Male - Age 23 - Weight 146

<u>Test Date 12/8/71</u>								
<u>Trial</u>	<u>BAQ</u>	<u>First Trial Pass</u>			<u>First 2 Trials Pass</u>			
		<u>Comp.</u> <u>Track</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	<u>Comp.</u> <u>Track</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	
1	0.00	P	P	P	P	P	P	
2	0.035	P	P	P	P	P	P	
3	0.08	F	F	P	F	F	F	
4	0.11	F	F	F	F	F	F	
5	0.085	P	F	F	P	F	F	
6	0.075	P	P	P	P	F	P	
7	0.04	P	F	P	P	F	P	

<u>Test Date 12/13/71</u>								
1	0.00	P	P	F	P	P	F	
2	0.05	P	P	F	P	P	F	
3	0.08	P	P	P	P	F	F	
4	0.095	P	F	F	P	F	F	
5	0.07	P	P	P	P	P	F	
6	0.04	P	P	P	P	P	P	
7	0.05	P	P	P	P	P	P	

<u>Test Date 12/17/71</u>								
1	0.00	P	P	P	P	P	F	
2	0.055	P	P	P	P	P	F	
3	0.065	P	F	F	P	F	F	
4	0.11	P	P	F	P	P	F	
5	0.06	P	P	P	P	F	P	
6	0.055	P	P	P	P	P	P	
7	0.05	P	P	P	P	P	P	

TABLE XI--Continued

Subject 6 - Social - Female - Age 22 - Weight 151

<u>Test Date 12/8/71</u>								
<u>First Trial Pass</u>					<u>First 2 Trials Pass</u>			
<u>Trial</u>	<u>BAQ</u>	Comp. <u>Track.</u>	Comp. <u>Test</u>	<u>Phystester</u>	Comp. <u>Track.</u>	Comp. <u>Test</u>	<u>Phystester</u>	
1	0.00	P	P	P	P	P	P	
2	0.06	P	P	P	P	P	P	
3	0.09	F	P	P	F	P	P	
4	0.11	P	F	F	P	F	F	
5	0.10	P	P	P	P	P	P	
6	0.065	P	P	P	P	P	P	
7	0.05	P	P	P	P	F	P	

<u>Test Date 12/13/71</u>								
1	0.00	P	P	P	P	P	P	
2	0.02	P	P	P	P	P	P	
3	0.065	P	P	P	P	P	F	
4	0.10	P	P	F	P	P	F	
5	0.075	P	P	P	P	P	P	
6	0.04	P	P	P	P	F	P	
7	0.035	P	P	F	P	P	F	

<u>Test Date 12/17/71</u>								
1	0.00	P	P	P	P	P	P	
2	0.025	P	P	P	P	P	P	
3	0.06	P	P	P	P	P	P	
4	0.105	P	P	P	P	F	F	
5	0.08	P	F	P	P	F	P	
6	0.06	P	P	F	P	P	F	
7	0.05	P	P	P	P	P	P	

TABLE XI--Continued

Subject 7 - Social - Male - Age 28 - Weight 180

Test Date 12/8/71

<u>Trial</u>	<u>BAQ</u>	<u>First Trial Pass</u>			<u>First 2 Trials Pass</u>		
		<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>
1	0.00	P	P	P	P	F	F
2	0.035	P	F	P	P	F	P
3	0.10	F	F	P	F	F	P
4	0.065	P	F	P	P	F	P
5	0.035	P	P	P	P	P	P
6	0.02	P	P	P	P	P	P
7	0.01	P	P	P	P	F	P

Test Date 12/13/71

1	0.00	P	F	P	P	F	P
2	0.02	P	P	P	P	P	P
3	0.055	P	F	F	P	F	F
4	0.09	P	P	F	P	F	F
5	0.055	P	P	F	P	P	F
6	0.045	P	P	P	P	P	P
7	0.02	P	P	P	P	P	P

Test Date 12/17/71

1	0.00	P	P	P	P	P	P
2	0.01	P	P	P	P	F	P
3	0.035	P	P	P	P	P	P
4	0.06	P	F	P	P	F	P
5	0.04	P	P	P	P	F	P
6	0.02	P	P	P	P	F	P
7	0.01	P	F	F	P	F	F

TABLE XI--Continued

Subject 8 - Social - Male - Age 24 - Weight 162

<u>Test Date 12/16/71</u>								
<u>Trial</u>	<u>BAQ</u>	<u>First Trial Pass</u>			<u>First 2 Trials Pass</u>			
		<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	
1	0.00	P	P	P	P	P	P	
2	0.02	P	P	P	P	P	P	
3	0.085	P	P	P	P	P	P	
4	0.12	F	P	F	F	P	F	
5	0.065	P	F	P	F	F	P	
6	0.06	F	P	P	F	P	P	
7	0.05	P	P	P	P	P	P	

<u>Test Date 12/20/71</u>								
1	0.00	P	P	P	P	P	P	
2	0.025	P	P	P	P	P	F	
3	0.06	P	P	P	P	P	P	
4	0.115	F	P	P	F	P	P	
5	0.09	P	P	P	P	P	P	
6	0.05	P	P	P	P	P	P	
7	0.02	P	P	P	P	P	P	

<u>Test Date 12/23/71</u>								
1	0.00	P	P	F	P	P	F	
2	0.02	P	P	F	P	P	F	
3	0.085	P	P	P	F	P	F	
4	0.09	P	P	F	P	P	F	
5	0.06	P	P	P	P	P	P	
6	0.05	P	P	P	P	P	P	
7	0.035	P	P	P	P	P	P	

TABLE XI--Continued

Subject 9 - Social - Male - Age 28 - Weight 160

<u>Test Date 12/16/71</u>								
<u>Trial</u>	<u>BAQ</u>	<u>First Trial Pass</u>			<u>First 2 Trials Pass</u>			
		<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	
1	0.00	F	P	F	F	P	F	
2	0.03	F	P	P	F	P	P	
3	0.10	P	F	P	P	F	P	
4	0.12	F	P	F	F	F	F	
5	0.06	F	F	P	F	F	P	
6	0.055	F	P	P	F	P	P	
7	0.035	F	P	P	F	P	P	

<u>Test Date 12/20/71</u>								
1	0.00	F	P	P	F	P	P	
2	0.03	F	P	P	F	P	P	
3	0.075	P	F	P	P	F	P	
4	0.125	F	F	F	F	F	F	
5	0.095	F	P	P	F	P	P	
6	0.07	F	P	P	F	P	P	
7	0.06	P	P	P	P	P	P	

<u>Test Date 12/23/71</u>								
1	0.00	P	P	P	P	P	P	
2	0.055	F	P	P	F	P	P	
3	0.07	P	P	P	P	P	P	
4	0.12	F	P	P	F	P	P	
5	0.085	F	P	P	F	P	P	
6	0.07	F	P	P	F	P	P	
7	0.035	P	P	P	P	P	P	

TABLE XI--Continued

Subject 10 - Social - Male - Age 25 - Weight 127

Test Date 12/16/71

<u>First Trial Pass</u>					<u>First 2 Trials Pass</u>		
<u>Trial</u>	<u>BAQ</u>	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>	<u>Comp. Track.</u>	<u>Comp. Test</u>	<u>Phystester</u>
1	0.00	P	P	P	P	P	P
2	0.045	F	F	P	F	F	P
3	0.075	F	F	P	F	F	P
4	0.10	F	F	P	F	F	P
5	0.07	F	P	P	F	P	P
6	0.05	F	P	P	F	P	P
7	0.02	P	P	P	P	F	P

Test Date 12/20/71

1	0.00	F	P	P	F	P	P
2	0.02	F	P	P	F	P	P
3	0.095	F	F	P	F	F	P
4	0.110	F	F	P	F	F	P
5	0.07	F	F	P	F	F	P
6	0.05	F	F	P	F	F	F
7	0.03	F	F	P	F	F	P

Test Date 12/23/71

1	0.00	F	P	P	F	P	P
2	0.055	F	P	P	F	P	P
3	0.095	P	P	P	P	P	F
4	0.105	F	P	P	F	P	P
5	0.06	F	P	P	F	P	P
6	0.03	F	P	P	F	P	P
7	0.02	F	P	P	F	P	P

TABLE XI--Continued

Subject 11 - Social - Female - Age 26 - Weight 140

<u>Test Date 12/16/71</u>								
<u>Trial</u>	<u>BAQ</u>	<u>First Trial Pass</u>			<u>First 2 Trials Pass</u>			
		<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	
1	0.00	P	F	P	P	F	P	
2	0.04	P	P	F	P	F	F	
3	0.09	F	P	P	F	F	P	
4	0.13	P	P	P	P	P	P	
5	0.08	F	P	P	F	P	P	
6	0.07	P	P	P	P	P	P	
7	0.035	F	P	P	F	F	P	

<u>Test Date 12/20/71</u>								
1	0.00	P	P	P	P	P	P	
2	0.04	P	F	F	P	F	F	
3	0.09	P	F	P	P	F	P	
4	0.145	F	F	P	F	F	P	
5	0.08	P	P	P	P	P	F	
6	0.06	P	P	P	P	F	P	
7	0.035	P	P	P	P	P	P	

<u>Test Date 12/23/71</u>								
1	0.00	P	P	P	P	P	P	
2	0.06	P	P	P	P	P	P	
3	0.08	P	P	F	P	P	F	
4	0.105	P	P	F	P	P	F	
5	0.07	P	P	P	P	P	P	
6	0.05	P	P	P	P	P	P	
7	0.02	P	P	P	P	P	F	

TABLE XI--Continued

Subject 12 - Social - Female - Age 22 - Weight 130

<u>Test Date 12/29/71</u>								
<u>Trial</u>	<u>BAQ</u>	<u>First Trial Pass</u>			<u>First 2 Trials Pass</u>			
		<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	
1	0.00	P	P	P	P	P	P	
2	0.03	P	P	P	P	P	P	
3	0.07	P	P	F	P	P	F	
4	0.11	F	F	P	F	F	P	
5	0.07	F	P	P	F	F	P	
6	0.07	F	P	P	F	F	P	
7	0.05	F	P	P	F	P	P	
<u>Test Date 1/3/72</u>								
1	0.00	P	P	F	P	P	F	
2	0.03	P	P	P	P	P	P	
3	0.08	P	P	P	F	P	P	
4	0.095	F	F	F	F	F	F	
5	0.055	P	P	P	P	P	P	
6	0.05	F	P	P	F	P	P	
7	0.025	P	P	P	P	P	P	
<u>Test Date 1/7/72</u>								
1	0.00	P	P	P	P	P	P	
2	0.04	P	P	P	P	P	P	
3	0.08	P	P	P	P	P	P	
4	0.12	F	P	P	F	P	P	
5	0.06	P	P	F	P	P	F	
6	0.06	P	P	P	P	P	P	
7	0.05	P	P	P	P	F	P	

TABLE XI--Continued

Subject 13 - Social - Female - Age 21 - Weight 127

<u>Test Date 12/29/71</u>							
<u>First Trial Pass</u>					<u>First 2 Trials Pass</u>		
<u>Trial</u>	<u>BAQ</u>	<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>
1	0.00	P	P	F	P	P	F
2	0.04	P	P	P	P	P	P
3	0.065	F	F	P	F	F	F
4	0.09	F	F	F	F	F	F
5	0.08	P	P	P	P	P	P
6	0.05	P	F	P	P	F	P
7	0.04	P	P	P	P	F	F

<u>Test Date 1/3/72</u>							
1	0.00	P	F	P	P	F	F
2	0.045	P	P	P	P	P	F
3	0.07	F	F	P	F	F	P
4	0.075	P	P	P	P	P	F
5	0.045	P	P	P	P	P	P
6	0.02	P	P	P	P	P	P
7	0.02	P	P	P	P	P	P

<u>Test Date - 1/7/72</u>							
1	0.00	P	P	P	P	F	P
2	0.065	P	P	P	P	P	P
3	0.065	P	P	F	P	P	F
4	0.06	P	P	P	P	P	P
5	0.035	P	P	P	F	P	P
6	0.02	P	P	P	P	P	F
7	0.05	P	P	P	P	P	P

TABLE XI--Continued

Subject 14 - Social - Male - Age 21 - Weight 161

<u>Test Date 12/29/71</u>								
<u>First Trial Pass</u>					<u>First 2 Trials Pass</u>			
<u>Trial</u>	<u>BAQ</u>	<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	
1	0.00	P	P	F	P	P	F	
2	0.02	P	P	P	P	P	P	
3	0.06	P	P	P	P	P	P	
4	0.08	F	P	F	F	F	F	
5	0.085	F	F	P	F	F	P	
6	0.075	P	P	P	P	F	P	
7	0.07	P	F	P	P	F	P	

<u>Test Date 1/3/72</u>								
1	0.00	P	P	P	P	P	P	
2	0.02	F	P	P	F	P	P	
3	0.035	P	P	P	P	P	F	
4	0.04	P	P	P	P	F	P	
5	0.02	P	P	P	P	F	P	
6	0.01	P	P	P	P	F	P	
7	0.00	P	P	P	P	P	P	

<u>Test Date 1/7/72</u>								
1	0.00	P	P	P	P	F	P	
2	0.04	P	P	P	P	P	P	
3	0.095	P	P	P	P	P	P	
4	0.07	F	F	F	F	F	F	
5	0.04	P	P	P	P	F	P	
6	0.04	P	P	P	P	P	P	
7	0.015	P	P	P	P	P	P	

TABLE XI--Continued

Subject 15 - Social - Male - Age 23 - Weight 151

<u>Test Date 12/29/71</u>								
<u>Trial</u>	<u>BAQ</u>	<u>First Trial Pass</u>			<u>First 2 Trials Pass</u>			
		<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	
1	0.00	P	F	F	P	F	F	
2	0.03	P	P	P	P	P	P	
3	0.07	F	P	F	F	F	F	
4	0.07	F	F	F	F	F	F	
5	0.045	F	P	F	F	F	F	
6	0.05	F	F	P	F	F	P	
7	0.05	F	P	P	F	P	P	

<u>Test Date 1/3/72</u>								
1	0.00	P	P	F	P	P	F	
2	0.03	P	P	F	P	P	F	
3	0.04	F	P	F	F	P	F	
4	0.045	F	F	P	F	F	P	
5	0.045	F	F	P	F	F	P	
6	0.015	P	F	P	P	F	P	
7	0.00	P	F	P	P	F	F	

<u>Test Date 1/7/72</u>								
1	0.00	F	F	P	F	F	P	
2	0.045	P	P	P	F	P	P	
3	0.06	P	F	P	P	F	P	
4	0.075	F	F	F	F	F	F	
5	0.08	P	P	P	P	P	P	
6	0.03	P	P	P	P	P	F	
7	0.025	P	P	P	P	F	P	

TABLE XI--Continued

Subject 16 - Social - Male - Age 31 - Weight 199

<u>Test Date 1/11/72</u>								
<u>First Trial Pass</u>					<u>First 2 Trials Pass</u>			
<u>Trial</u>	<u>BAQ</u>	<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	
1	0.01	P	F	P	P	F	P	
2	0.08	P	P	F	P	P	F	
3	0.095	F	F	F	F	F	F	
4	0.11	P	F	P	F	F	P	
5	0.075	F	F	P	F	F	P	
6	0.055	F	F	F	F	F	F	
7	0.04	F	P	P	F	F	P	

<u>Test Date 1/17/72</u>								
1	0.00	P	P	P	P	P	P	
2	0.055	P	F	P	P	F	P	
3	0.07	P	F	P	F	F	P	
4	0.13	F	F	P	F	F	F	
5	0.09	F	F	P	F	F	F	
6	0.065	P	P	P	P	F	P	
7	0.055	P	F	P	P	F	F	

<u>Test Date 1/21/72</u>								
1	0.00	P	F	P	P	F	P	
2	0.055	P	P	P	P	F	F	
3	0.085	F	P	P	F	F	P	
4	0.09	F	F	F	F	F	F	
5	0.065	P	P	F	P	P	F	
6	0.075	P	F	P	P	F	P	
7	0.03	P	F	P	P	F	P	

TABLE XI--Continued

Subject 17 - Social - Male - Age 22 - Weight 149

<u>Test Date 1/11/72</u>								
<u>First Trial Pass</u>					<u>First 2 Trials Pass</u>			
<u>Trial</u>	<u>BAQ</u>	<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	
1	0.00	P	P	P	P	P	P	
2	0.05	P	P	P	P	P	P	
3	0.075	P	P	P	P	P	P	
4	0.10	P	P	P	P	P	F	
5	0.075	P	P	P	P	P	P	
6	0.065	P	P	P	P	P	P	
7	0.05	P	P	P	P	P	P	

<u>Test Date 1/17/72</u>								
1	0.00	P	P	P	P	P	P	
2	0.035	P	P	P	P	P	P	
3	0.065	F	P	P	F	F	P	
4	0.115	F	P	P	F	P	P	
5	0.10	P	P	P	F	P	P	
6	0.095	P	P	P	P	P	P	
7	0.055	P	P	P	P	P	P	

<u>Test Date 1/21/72</u>								
1	0.00	P	P	P	P	P	P	
2	0.05	P	P	P	P	F	P	
3	0.075	P	P	P	P	P	P	
4	0.095	P	P	P	P	P	P	
5	0.065	P	P	P	F	P	P	
6	0.075	P	P	F	P	P	F	
7	0.035	P	P	P	P	P	P	

TABLE XI--Continued

Subject 18 - Social - Male - Age 22 - Weight 124

Test Date 1/11/72

Trial	BAQ	<u>First Trial Pass</u>			<u>First 2 Trials Pass</u>		
		Comp. Track.	Comp. Test	Phystester	Comp. Track.	Comp. Test	Phystester
1	0.00	P	P	F	P	P	F
2	0.045	P	P	P	P	P	P
3	0.09	F	P	P	F	P	P
4	0.115	P	P	F	F	P	F
5	0.06	F	P	P	F	P	P
6	0.06	P	P	P	P	P	P
7	0.05	P	P	P	P	P	F

Test Date 1/17/72

1	0.00	P	P	P	P	P	P
2	0.01	P	P	P	P	P	P
3	0.03	P	F	P	P	F	F
4	0.02	P	P	P	P	P	P
5	0.00	P	P	P	P	P	F
6	0.00	P	P	P	P	P	P
7	0.00	F	P	P	F	P	P

Test Date 1/21/72

1	0.00	P	P	P	P	P	P
2	0.01	P	F	P	P	F	P
3	0.03	F	P	P	F	F	P
4	0.04	P	P	P	P	P	P
5	0.02	P	P	P	P	P	P
6	0.01	P	P	P	P	P	P
7	0.00	P	P	P	P	P	P

TABLE XI--Continued

Subject 19 - Social - Male - Age 31 - Weight 199

Test Date 1/11/72

<u>Trial</u>	<u>BAQ</u>	<u>First Trial Pass</u>			<u>First 2 Trials Pass</u>		
		<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>
1	0.01	P	F	P	P	F	P
2	0.08	P	P	F	P	P	F
3	0.095	F	F	F	F	F	F
4	0.11	P	F	P	F	F	P
5	0.075	F	F	P	F	F	P
6	0.055	F	F	F	F	F	F
7	0.04	F	P	P	F	F	P

Test Date 1/17/72

1	0.00	P	P	P	P	P	P
2	0.055	P	F	P	P	F	P
3	0.07	P	F	P	F	F	P
4	0.13	F	F	P	F	F	F
5	0.09	F	F	P	F	F	F
6	0.065	P	P	P	P	F	P
7	0.055	P	F	P	P	F	F

Test Date 1/21/72

1	0.00	P	F	P	P	F	P
2	0.055	P	P	P	P	F	F
3	0.085	F	P	P	F	F	P
4	0.09	F	F	F	F	F	F
5	0.065	P	P	F	P	P	F
6	0.075	P	F	P	P	F	P
7	0.03	P	F	P	P	F	P

TABLE XI--Continued

Subject 20 - Social - Female - Age 26 - Weight 202

Test Date 1/11/72

<u>Trial</u>	<u>BAQ</u>	<u>First Trial Pass</u>			<u>First 2 Trials Pass</u>		
		<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>
1	0.00	P	P	P	P	P	P
2	0.075	P	P	P	P	P	P
3	0.095	P	F	P	P	F	P
4	0.105	P	F	F	P	F	F
5	0.07	F	F	P	F	F	P
6	0.06	P	P	P	P	P	P
7	0.04	P	P	P	P	P	P

Test Date 1/18/72

1	0.00	P	P	P	P	P	F
2	0.07	P	P	P	F	P	P
3	0.10	F	F	F	F	F	F
4	0.11	P	P	F	P	F	F
5	0.075	F	P	P	F	P	P
6	0.07	P	P	P	P	F	P
7	0.055	P	P	P	P	P	P

Test Date 1/21/72

1	0.015	P	P	P	P	P	F
2	0.05	P	P	P	P	F	P
3	0.10	P	P	P	F	P	F
4	0.11	P	P	P	P	P	F
5	0.08	P	P	P	P	P	P
6	0.075	P	P	P	P	P	P
7	0.045	P	P	P	P	P	P

TABLE XII. PERCENTILE SCORES FOR INTELLIGENCE TESTS FOR EACH SUBJECT TESTED IN PHASE III.

<u>Subject</u>	<u>Verbal</u>	<u>Numerical</u>	<u>Total</u>
1	87	92	*
2	90	79	*
3	99	34	96
4	78	61	72
5	95	96	96
6	2**	2**	2**
7	70	82	79
8	96	82	96
9	94	53	90
10	74	95	84
11	91	5	49
12	99	46	96
13	65	72	68
14	99	89	99
15	96	65	91
16	97	63	95
17	97	43	92
18	95	99	98
19	99	98	*
Mean:	85.42	66.11	81.37

*Subjects 1, 2, and 19 took the Personnel Tests for Industry, which do not have a total score. All other subjects took the Wesman Personnel Classification Test.

**This subject was foreign born and did not speak or write English well. His "native ability" appeared to be at least average, however.

TABLE XIII. NUMBER OF CORRECT RESPONSES FOR ALL CONTROL SUBJECTS ON EACH TEST TRIAL FOR ALL DEVICES. PHASE III.

<u>Test Date 1/25/72</u>					<u>Test Date 1/25/72</u>				
	<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	<u>QuicKey</u>		<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	<u>QuicKey</u>
S ₁	1	3	3	3	P	3	2	2	P
	2	3	3	3	P	3	3	3	P
	3	3	3	2	P	3	2	2	P
	4	3	3	2	P	3	3	3	P
	5	3	3	3	P	3	3	3	P
	6	3	3	3	P	3	3	3	P
	7	3	2	2	P	3	3	2	P
S ₃	1	2	3	3	P	3	2	3	P
	2	3	3	3	P	3	3	3	P
	3	3	3	3	P	3	2	3	P
	4	3	2	2	P	3	3	3	P
	5	3	3	3	P	3	3	3	P
	6	3	3	3	P	2	3	2	P
	7	3	3	3	P	3	2	2	P
<u>Test Date 1/14/72</u>					<u>Test Date 1/19/72</u>				
S ₅	1	1	1	3	P	2	3	3	P
	2	3	2	2	P	3	3	3	P
	3	3	2	3	P	1	2	3	P
	4	2	3	3	P	3	3	3	P
	5	3	3	2	P	3	3	3	P
	6	3	0	3	P	3	2	3	P
	7	3	2	3	P	3	2	3	P
S ₇	1	3	3	3	P	2	3	3	P
	2	3	3	3	P	3	3	3	P
	3	3	3	3	P	3	3	3	P
	4	3	3	3	P	3	3	3	P
	5	3	3	3	P	3	3	3	P
	6	3	3	3	P	3	3	3	P
	7	3	3	3	P	3	3	3	P

TABLE XIII--Continued

<u>Test Date 1/14/72</u>					<u>Test Date 1/19/72</u>				
	<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	<u>QuicKey</u>		<u>Comp.</u> <u>Track.</u>	<u>Comp.</u> <u>Test</u>	<u>Phystester</u>	<u>QuicKey</u>
S ₉	1	3	3	P	S ₁₀	3	3	2	P
	2	3	3	P		3	3	3	P
	3	3	2	P		3	3	3	P
	4	3	3	P		3	3	3	P
	5	2	3	P		3	3	3	P
	6	3	3	P		3	3	2	P
	7	3	3	P		3	2	3	P
S ₁₁	1	3	3	P	S ₁₂	3	3	3	P
	2	3	3	P		3	3	3	F
	3	3	3	P		3	3	3	P
	4	3	2	P		3	2	3	P
	5	3	3	P		3	3	3	F
	6	3	3	P		3	3	3	P
	7	3	3	P		3	1	3	F

TABLE XIV. RESPONSES FROM SOCIAL AND REGISTRY SUBJECTS (AS GROUPS) TO REPRESENTATIVE QUESTIONS ON THE DRINKING HISTORY QUESTIONNAIRE.

Question	Social (N=33)*				Registry (N=13)			
	Yes	No	No Ans.	Ave.# (range)	Yes	No	No Ans.	Ave.# (range)
1. Have you ever been in a court or penal institution?	9	24	0	-	13	0	0	-
If yes, before you were arrested had you								
1. not been drinking?	6							
2. drunk 1-4 drinks?	2				4			
3. drunk 5 or 6 drinks	0				2			
4. 7 or more	0				6			
5. an indeterminate amount to drink?	1				1			
Did you drink this amount								
1. under 2 hrs.?	2				4			
2. from 2-4 hrs.?					4			
3. from 4-8 hrs.?					2			
4. through the day?					3			
2. Have you been arrested for driving under the influence of liquor or for impaired driving?	0	33			13	0		1.3 (1-3)
how many times?								
3. Have you ever been arrested for being drunk and disorderly or for public intoxication?	0	33			8	5		1 (1-2)
how many times?								
4. Have you ever been arrested for reckless driving?	0	33			1	12		1
how many times?								
5. Have you ever been arrested for anything else?	9	24		1.6 (1-4)	6	7		1.6 (1-2)
how many times?								
6. Have you received any traffic tickets in the past two years?	7			1.25 (1-3)	4			1.75 (1-4)
how many?								

TABLE XIV--Continued

Question	Social (N=33)				Registry (N=13)			
	Yes	No	No Ans.	Ave.# (range)	Yes	No	No Ans.	Ave.# (range)
7. While driving have you ever been stopped by police, but not ticketed when you knew you had been drinking too much?	4	29			3	10		
8. Has your driver's license ever been suspended or revoked in Mass. or any state?	8	25		1.25 (1-2)	13	0		1.5 (1-3)
9. Do you recall your use when you first started drinking? What Age?	33	0		(14)	13	0		(14)
10. Do you feel that drinking is causing any problems in your life?	5	28			8	5		
11. Do you feel that you always drink like a social drinker?	23	10			3	10		
12. Do you ever find you drink more than you had intended to drink?	17	16			10	3		
Do you ever get drunk without intending to?	13	20			8	5		
13. Do you usually drink every day?	8	25			3	10		
If no, indicate how many days a week you usually do drink? (zero means less than once per week)				2.8 (0-5)				2.5 (0-6)
14. At one sitting do you usually drink:								
1. 4 or less drinks?					6			
2. 5 or 6 drinks?					6			
3. 7 or more?					1			

TABLE XIV--Continued

Question	Social (N=33)				Registry (N=13)			
	Yes	No	No Ans.	Ave.# (range)	Yes	No	No Ans.	Ave.# (range)
15. Have you gone on a drinking spree or binge in the last 5 years?	9	24			4	9		
16. Have you ever been treated for drinking?	0	33			2	11		
17. Do you feel that your health would be better if you decreased or stopped drinking?	9	24			10	3		
18. In the past two years did you go to your doctor or the emergency room because you injured yourself?	8	25			2	11		
If yes, had you been drinking when this happened?	2	6			1	1		
19. If now or previously married, did you ever have family arguments about drinking?	1	8	25		5	4	4	
20. Do you feel that you are a problem drinker?	1	32			4	9		

*Of 34 Social Ss in Study, 33 Questionnaires were surveyed.

GLOSSARY OF TERMS

A. S. Dwan - a device produced by (Engineers) Limited
23 Grenaby Road
Croyden, England CR02E

BAQ - blood alcohol equivalent: the percent blood alcohol equivalent to a given alveolar alcohol level.

Breathalyzer - a trade name for a device manufactured by
Stevenson Corporation
Redbank, New Jersey
Used to determine subjects' alveolar alcohol levels.

Compensatory Tracking (Comp. Track) - a device fabricated by
U.S. Department of Transportation
Transportation Systems Center
55 Broadway
Cambridge, Massachusetts 02142

Complex Reaction Tester (Comp. Test) - a device fabricated by
U.S. Department of Transportation
Transportation Systems Center
55 Broadway
Cambridge, Massachusetts 02142

Control Subjects - Subjects who were tested on the devices for seven trials with the same schedule as drinking subjects, but who received 8 ounces of juice with no alcohol for each drink.

Creare - a device produced by Creare Inc.
Science and Technology
Hanover, New Hampshire 03755

Drink 1 (D_1) - The alcohol dose calculated to bring subjects' blood alcohol levels up to approximately 0.05%.

Drink 2 (D_2) - the alcohol dose calculated to bring social subjects' and registry subjects' blood alcohol levels up to approximately 0.09% and 0.10% respectively.

Drink 3 (D_3) - the alcohol dose calculated to bring social subjects' and registry subjects' blood alcohol levels up to approximately 0.12% and 0.15% respectively.

Drunken Driver Eliminator (DDE) - a device produced by
TDL Group of Companies
7117 Silver, S.E.
Albuquerque, New Mexico 87108

Phystester - a device produced by Delco Electronics
Division of General Motors Corporation
Milwaukee, Wisconsin 53201

Pursuit Tracking (Pursuit Track.) - a device fabricated by
U.S. Department of Transportation
Transportation Systems Center
55 Broadway
Cambridge, Massachusetts 02142

QuicKey - a device manufactured by Robert D. Smith
7860 Glade
Canoga Park, California 91304

Registry Subjects (Problem Drinkers) - those subjects who had a history of at least one offense of driving while intoxicated, which resulted in an arrest. Assumed to be heavy alcohol drinkers, with problems related to alcohol drinking. This assumption was verified by the subjects' drinking histories.

Repetitions - the number of times (or trials) that subjects were tested on each device at each testing session (trials 1-7).

Repetitions x Subjects - the interaction of repetitions by subjects, or the variability in subjects' responses as a function of each repetition. This is the error term for the repetitions main term.

Repetitions x Trials x Subjects - the simultaneous interaction of repetitions by trials by subjects, or the variability of subjects' responses as a function of the joint effect of repetitions and each trial or blood alcohol level tested.

Social Subjects (Social Drinkers) - those subjects who had no history of driving offense related to alcohol which resulted in an arrest. Assumed to be light-moderate alcohol drinkers with no problems related to alcohol drinking. This assumption was verified by the subjects' drinking histories.

Subjects - when used in the description of this experiment this term, of course, refers to those individuals who were exposed to

alcohol and then tested for performance. (Subject is abbreviated S.) When used in the tables of analysis of variance the word subjects is a contraction for the term inter subject variability.

Trial 0 - this refers to the 7 testing sessions on the devices performed at various blood alcohol levels.

Trial 1 (T_1) - the testing period on the devices before any alcohol ingestion for control data.

Trial 2 (T_2) - the testing period on the devices approximately 25 minutes after the ingestion of the first drink.

Trial 3 (T_3) - the testing period on the devices approximately 25 minutes after the ingestion of the second drink.

Trial 4 (T_4) - the testing period on the devices approximately 25 minutes after the ingestion of the third drink.

Trial 5 (T_5) - the testing period on the devices approximately 2 1/2 hours after the completion of alcohol intake.

Trial 6 (T_6) - the testing period on the devices approximately 3 1/2 hours after the completion of alcohol intake.

Trial 7 (T_7) - the testing period on the devices approximately 4 1/2 hours after the completion of alcohol intake.

Trial x Subjects - the interaction of trials by subjects, or the variability in subjects' responses as a function of each trial or blood alcohol level tested.

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