DOT-CG-D-04-90
DOT-TSC-CG-90-2

An Experimental Evaluation of a Field Sobriety Test Battery in the Marine Environment

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June 1990
Final Report

U.S. Department of Transportation
United States Coast Guard

Office of Navigation Safety and Waterway Services
Auxiliary, Boating and Consumer Affairs Division
Washington, DC 20593

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Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT-CG-D-04-90		

4. Title and Subtitle	5. Report Date
An Experimental Evaluation of a Field Sobriety Test Battery in the Marine Environment	June 1990
	6. Performing Organization Code: DTS-45
	8. Performing Organization Report No.: DOT-TSC-CG-90-2
7. Author(s): E. Donald Sussman, Peter H. Mengert	
9. Performing Organization Name and Address: U.S. Department of Transportation, Research and Special Programs Administration, Transportation Systems Center, Cambridge, MA 02142	10. Work Unit No. (TRAIS): CG074/B0024
	11. Contract or Grant No.
	13. Type of Report and Period Covered: Final Report, March 1987-February 1990
12. Sponsoring Agency Name and Address: U.S. Department of Transportation, United States Coast Guard, Office of Navigation Safety and Waterway Services, Washington, DC 20593	14. Sponsoring Agency Code: G-NAB

15. Supplementary Notes

16. Abstract

This Report describes an investigation of the accuracy of a FST (Field Sobriety Test) battery used in the marine environment. FSTs rely on the observation and measurement of the effect of alcohol intoxication on coordination, visual tracking and balance. The purpose of this study was to determine if there was any decrease in the accuracy of the tests when used under recreational boating conditions.

In the study, 97 volunteers were dosed with alcohol (four drinks over three and one half hours) in a recreational boating setting. The subjects' BACs (Blood Alcohol Concentration) were estimated through FST procedures by marine law enforcement agents experienced in the use of such procedures.

The officers correctly identified the subjects who would be legally intoxicated (BACs equal to or greater than 0.10%) in 82% of all cases.

The overall correlation of the officers' FST based estimates with BACs obtained using breath tests was approximately .70. This level is consistent with similarly obtained correlations from highway studies.

Calculation of indices of the officers' arrest-release performances revealed that FST tests used on the water can result in the arrest of significantly more intoxicated boaters while maintaining a very low level of false arrests.

It was concluded that the accuracy of FST batteries are not degraded in the marine environment.

17. Key Words	18. Distribution Statement
Field Sobriety Tests, Alcohol, Recreational Boats	DOCUMENT IS AVAILABLE TO THE PUBLIC THROUGH THE NATIONAL TECHNICAL INFORMATION SERVICE, SPRINGFIELD, VIRGINIA 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
UNCLASSIFIED	UNCLASSIFIED	96	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

Preface

This study was carried out for the U.S. Coast Guard's Office of Boating, Public, and Consumer Affairs (after reorganization, the Office of Navigation Safety and Waterways Services) and the U.S. Coast Guard's Office of Engineering, Logistics and Development by the Transportation Systems Center's Operator Performance and Safety Analysis Division, in cooperation with the International Association of Chiefs of Police.

The study received the enthusiastic, creative, and active support of individuals from a number of diverse organizations. We would like to acknowledge the efforts of the following organizations and individuals:

The U.S. Coast Guard Headquarters staff members, who provided not only overall program direction and coordination but the encouragement and institutional support which was vital to the execution of the study: A. J. Marmo, Capt. M.B. Stegner, Lt. John Smith, Lt. William Cairns, and CWO3 John Williams; the Yorktown Reserve Training Center (RTC) staff who provided vital logistic support, In, particular Lt. Commander T. Doherty, Lt. Mark Kern, and Chief "Corky" Elliot.

Capt. C. Richard Mockler, TSC Coast Guard Coordinator for his guidance and assistance.

The staff from the International Association of Chiefs of Police, Charles Peltier and Ron Sostkowski for securing the cooperation of the police officers who served as raters and for their aid in study planning and design. The creative and untiring efforts of the research team from Dunlap and Associates who recruited, dosed, and monitored the subjects.

Robert DiSario and Paul Hoxie of TSC for their thorough and insightful review of the statistical design and Arthur Flores and Arnold Spicer for their supervision of the breath testing.

The members of the law enforcement community who were involved in the study; Capt. Frank Wood, Maryland Department of Natural Resources and Randy Smith and Pam Dillon, Ohio Department of Natural Resources for their support in providing the raters and the six marine law enforcement officers who served as raters.

We also thank the ninety-seven men who served as subjects and their respective organizations: RTC Yorktown, U.S. Coast Guard Fifth District, Fort Eustis, and the Naval Weapons Station. We also thank the volunteers from the U.S.Coast Guard Auxiliary who served as boat operators.

Finally special thanks is given to program monitor Jerry Boden for his continued meticulous and dedicated support of all phases of the effort from planning through final technical review.

METRIC / ENGLISH CONVERSION FACTORS

ENGLISH TO METRIC

LENGTH (APPROXIMATE)

1 inch (in) = 2.5 centimeters (cm)
1 foot (ft) = 30 centimeters (cm)
1 yard (yd) = 0.9 meter (m)
1 mile (mi) = 1.6 kilometers (km)

AREA (APPROXIMATE)

1 square inch (sq in, in^2) = 6.5 square centimeters (cm^2)
1 square foot (sq ft, ft^2) = 0.09 square meter (m^2)
1 square yard (sq yd, yd^2) = 0.8 square meter (m^2)
1 square mile (sq mi, mi^2) = 2.6 square kilometers (km^2)
1 acre = 0.4 hectares (he) = 4,000 square meters (m^2)

MASS - WEIGHT (APPROXIMATE)

1 ounce (oz) = 28 grams (gr)
1 pound (lb) = .45 kilogram (kg)
1 short ton = 2,000 pounds (lb) = 0.9 tonne (t)

VOLUME (APPROXIMATE)

1 teaspoon (tsp) = 5 milliliters (ml)
1 tablespoon (tbsp) = 15 milliliters (ml)
1 fluid ounce (fl oz) = 30 milliliters (ml)
1 cup (c) = 0.24 liter (l)
1 pint (pt) = 0.47 liter (l)
1 quart (qt) = 0.96 liter (l)
1 gallon (gal) = 3.8 liters (l)
1 cubic foot (cu ft, ft^3) = 0.03 cubic meter (m^3)
1 cubic yard (cu yd, yd^3) = 0.76 cubic meter (m^3)

TEMPERATURE (EXACT)

[(x - 32) (5/9)] °F = y °C

METRIC TO ENGLISH

LENGTH (APPROXIMATE)

1 millimeter (mm) = 0.04 inch (in)
1 centimeter (cm) = 0.4 inch (in)
1 meter (m) = 3.3 feet (ft)
1 meter (m) = 1.1 yards (yd)
1 kilometer (km) = 0.6 mile (mi)

AREA (APPROXIMATE)

1 square centimeter (cm^2) = 0.16 square inch (sq in, in^2)
1 square meter (m^2) = 1.2 square yards (sq yd, yd^2)
1 square kilometer (km^2) = 0.4 square mile (sq mi, mi^2)
1 hectare (he) = 10,000 square meters (m^2) = 2.5 acres

MASS - WEIGHT (APPROXIMATE)

1 gram (gr) = 0.036 ounce (oz)
1 kilogram (kg) = 2.2 pounds (lb)
1 tonne (t) = 1,000 kilograms (kg) = 1.1 short tons

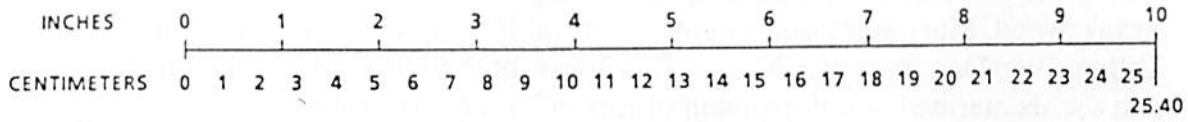
VOLUME (APPROXIMATE)

1 milliliter (ml) = 0.03 fluid ounce (fl oz)
1 liter (l) = 2.1 pints (pt)
1 liter (l) = 1.06 quarts (qt)
1 liter (l) = 0.26 gallon (gal)
1 cubic meter (m^3) = 36 cubic feet (cu ft, ft^3)
1 cubic meter (m^3) = 1.3 cubic yards (cu yd, yd^3)

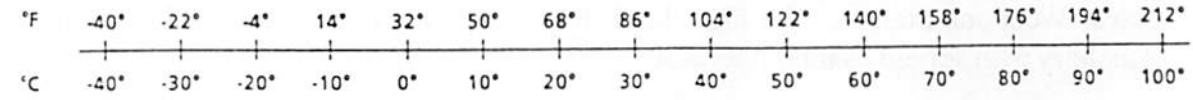
TEMPERATURE (EXACT)

[(9/5) y + 32] °C = x °F

QUICK INCH-CENTIMETER LENGTH CONVERSION



QUICK FAHRENHEIT-CELCIUS TEMPERATURE CONVERSION



For more exact and or other conversion factors, see NBS Miscellaneous Publication 286, Units of Weights and Measures. Price $2.50. SD Catalog No. C13 10 286.

Executive Summary

This Report describes an investigation of the accuracy of a field sobriety test (FST) battery when used in the marine environment. FSTs are non-chemical tests of intoxication which are used in highway law enforcement. These tests rely on the observation and measurement of the effect of alcohol intoxication on behaviors such as coordination, visual tracking and balance. It has been suggested that such behaviors might be degraded by the stressors encountered in the marine environment thereby invalidating them for such use. The purpose of this study was to determine if there was any decrease in the accuracy of the tests when used on individuals in recreational boating conditions.

In the study, 97 volunteers (who were similar in age to the population of individuals arrested for operating under intoxication (OUI) encountered in MD., OH., and two counties in CA. during a two year period) were dosed with alcohol in a setting closely approximating that encountered in recreational boating. The subjects were given four drinks over a three and one half hour exposure period. The dosages were calculated to cause the subject to reach Blood Alcohol Concentrations (BACs) of 0.12%, 0.08%, or 0%. During this exposure period the subjects spent approximately one and one half hours on the water at various speeds in an open, high performance outboard type boat.

The subjects' BACs were estimated through FST procedures by marine law enforcement agents experienced in the use of such procedures. The FSTs were conducted both on the water and on land. The officers correctly classified the subjects' BACs to be either below 0.10% or equal to or greater than 0.10% in 82% of all cases. The Coast Guard's limit for OUI for recreational boating is 0.10%.

The officers' estimates were correlated with measurements of BAC obtained using breath testing units. The correlations obtained were similar to and consistent with correlations between FST estimates of BAC and breath test measurements found in studies conducted to simulate the highway environment. The overall correlation was approximately .70.

Indices of the officer's performance in correctly determining whether a subject did or did not exceed an intoxication criteria were calculated. These indices revealed that, even when used in a "conservative" manner, FST tests used on the water will result in the arrest of a significantly greater number of intoxicated boaters than would be arrested using only observation and interrogation methods and would probably result in a very low level of false arrests. ("Conservative" manner refers to a situation in which the officer would arrest only suspects who were believed to have BAC levels of at least 0.02% above the legal BAC level for intoxication).

It was concluded that the accuracy of FSTs is not degraded by the marine environment.

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

Figure — Page

Table — Page

1 INTRODUCTION

1.1 Objective

The objective of this study was to determine the usefulness of a field sobriety test (FST) battery in assisting the marine law enforcement officer in determining if boat operators are intoxicated. This is part of the Coast Guard's effort to support local marine law enforcement. This study was performed in cooperation with the International Association of Chiefs of Police (IACP), which will use the information generated in assembling a boating safety manual focusing on the issue of alcohol detection.

Field sobriety tests have been verified as useful techniques in the detection of the intoxicated automobile operator (Tharp, et al., 1981). Since certain stressors are present in the boating environment which are not present on the highway, it is necessary to evaluate the effectiveness of these tests in the marine environment. It has been hypothesized that stressors inherent in marine operations (i.e., the effects of heat, spray, boat motion, vibration, glare) may cause boaters (whether intoxicated or sober) to perform poorly on field sobriety tests. It is, therefore, the intent of this study to determine the effectiveness of a battery of field sobriety tests in aiding the officer to differentiate between sober and intoxicated boat operators who have been exposed to the same marine environmental conditions.

In practice, when an officer suspects that a boater is operating while intoxicated, he or she will stop the boat and observe the appearance, demeanor, and behavior of the suspect. The officer may then ask the suspect to perform certain field sobriety tests. The results of these observations and tests are used to determine whether to detain the boater in order to obtain the breath, blood or urine sample required to perform a chemical test to determine the boater's BAC (Blood Alcohol Concentration). Detention of an individual who does not exceed the legal limit is an inconvenience to the boater and a waste of time for the officer. This is true even in cases where the officer carries a portable breath tester because he or she must wait approximately ten minutes before taking the sample in order to eliminate the possibility that alcohol remaining in the mouth will contaminate the sample.

When chemical tests of BAC are used as evidence, they are frequently challenged based on the accuracy of the test instruments, the procedures followed, and the custody of the evidence. The results of valid field sobriety tests could be used not only to increase the accuracy of arrest/release decisions made by the marine officer but also as evidence in court procedures.

1.2 Study Background

Boating safety statistics compiled by the U.S. Coast Guard (Boating Statistics 1986) indicate that 1,066 lives were lost in 1986 as a result of recreational boating accidents. The role of alcohol as contributing to the cause of these accidents is not known.

In order to investigate the role of alcohol in recreational boating safety, the U.S. Coast Guard contracted with the Transportation Research Board of the National Research Council to identify and develop a list of research efforts which would improve our understanding of the role of alcohol intoxication in marine safety and support law enforcement efforts.

In February 1986 the TRB report "Workshop on Alcohol-Related Accidents in Recreational Boating" was published. The Coast Guard selected three of the efforts from the report and arranged for support from the Transportation Systems Center in their conduct.

The efforts selected were:

l. Assessment of the increased risk associated with alcohol intoxication and fatal accidents in recreational boating.

2. Identification and evaluation of remote detection cues for alcohol intoxication in recreational boat operators.

3. Assessment of the effectiveness of non-chemical tests of intoxication in the marine environment.

This report describes the third effort.

1.3 Background - Field Sobriety Testing

The police officer in the field may use a number of tools in assessing the sobriety of a suspect, including: observation, interrogation, a series of performance tests known as "field sobriety tests", and Portable Breath Testing (PBT) units. The evidence derived through the accumulation of information provided by these indicators of intoxication is used in the process of developing probable cause for an OUI (Operating Under the Influence) arrest. One might ask, "If the officer can determine the suspect's BAC through use of a PBT, why is it necessary to also give field sobriety tests?". PBTs do provide a quick and reliable estimate of blood alcohol concentration (BAC). However, it must be understood that very few states have marine per se laws (laws which specify

the legal BAC level for intoxication) and implied consent laws (laws which require a boat operator to submit to a PBT or other chemical BAC test). Even if a state has a marine per se law (OUI is defined as a BAC exceeding some number) and an implied consent law requiring a suspect to submit to a chemical test to determine BAC, a PBT reading alone is not necessarily sufficient evidence to support an OUI charge. The suspect may claim that the PBT unit was not properly calibrated, or that the officer misread the reading. Field sobriety tests provide evidence of impaired behavior which can support the OUI charge. In general, the determination of a case is usually based on the accumulation of evidence and rarely rests on only one indicator of possible guilt. In this study the non-chemical behavioral indicators of intoxication are evaluated.

Currently, highway officers use a recognized battery of field sobriety tests, which has been validated as an effective means for assessing impaired behavior. A specified criteria has been established for "normal" behavior within each of these tests. After the officer has ruled out the possibility of impairment due to age, physical condition, illness, disability or fatigue, it is assumed that deviations from "normal" performance are attributable to intoxication.

The results of this testing are used to support the officer's contention that there exists probable cause to arrest the operator. Many of these tests are also routinely used by marine law enforcement officers in identifying the OUI boater. However, until now these tests have not been systematically examined for their validity of use in the marine environment.

An assessment of "Psychophysical Tests for DWI (Driving While Intoxicated) Arrest" was performed for the U.S. Department of Transportation, NHTSA, by Burns and Moskowitz (1977). They examined the effectiveness of six tests for their sensitivity as predictors of impairment attributable to alcohol consumption. All six tests were found to be "alcohol sensitive". The officers were found to make correct arrest/release decisions for 76% of the participants. The six tests studied were: One-Leg Stand, Walk and Turn, Horizontal Gaze Nystagmus, Finger to Nose, Finger Count, and Tracing. Of these six tests, Walk and Turn, One-Leg Stand, and Horizontal Gaze Nystagmus were identified as the three "best predictors" of intoxication and were recommended for use as an "abbreviated battery".

Tharp, Burns, and Moskowitz (1981) studied the effectiveness of the abbreviated test battery. When officers used the Walk and Turn, One-Leg Stand, and Horizontal Gaze Nystagmus they were able to correctly classify 81% of the subjects as being above or below 0.10% BAC.

In the present study, five of the six above mentioned "alcohol sensitive" tests were examined in the marine environment. The Tracing task was omitted since paper and pencil tasks are difficult for all boaters to perform (regardless of alcohol consumption) due to the motion of a boat as it is affected by waves and wakes. Two additional field sobriety tests were added to this basic battery, since they are currently used in marine law enforcement and are considered to be effective by the states using them (CA., MD., and OH.). They are the Alphabet Recital and Hand Pat Test. These tests are easily and quickly administered in the marine environment.

2 METHOD

This was a controlled experimental study in which a field sobriety test battery consisting of FSTs commonly used in highway law enforcement were studied in the marine environment. Their effectiveness as predictors of BAC was assessed. Ninety-seven subjects from a population of Coast Guard, Army, and Marine personnel in the Yorktown, VA. area, participated in the study.

All study procedures involving the use of human subjects were reviewed by an "Institutional Review Board", which was convened by Dunlap and Associates. This was an independent committee whose primary concern was for the safety of the subjects. All study procedures were approved by the committee.

Subjects were dosed, with measured mixtures of grain alcohol and fruit juice, to one of three levels of Blood Alcohol Concentration (BAC) in accordance with their drinking history and body weight. The three target BAC levels were 0.00%, 0.08%. and 0.12%. Dosing occurred mainly on land (three drinks during a two hour period), with the final (fourth) drink consumed on the boat. Subjects were exposed to the marine environment, i.e., a 90 minute boat ride as passenger. Subjects were passengers rather than operators for their own safety. There was no reason to allow the subjects to operate the boats, since the study deals with the effects of exposure to the marine environment on field sobriety test performance and not on boat handling.

A BAC measurement was taken on the boat prior to commencing field sobriety testing. The researcher measured the subject's BAC through use of a PBT. The results were not revealed to the subject or officers. Field sobriety tests were then given on the boat by a team of three marine law enforcement officers. One officer (rater #1) served as the lead officer, administering the tests while the other two officers observed. All officers administered the Horizontal Gaze Nystagmus individually, since it requires face-to-face contact with the suspect in order to rate performance. After giving a test or pair of tests (as designated) each officer on the team gave a written estimate of the subject's BAC level. Estimates of each officer were kept confidential so that one officer could not be influenced by the estimate of others. The subject was then transported to land. Field sobriety tests were then given on land by the same team of three officers. One officer (rater #2) served as the lead officer, administering the tests while the other two officers observed. All officers administered the Horizontal Gaze Nystagmus (HGN) individually. After giving a test or pair of tests (as designated) each officer on the team gave a written estimate of the subject's BAC level.

The sequence of testing was similar to actual arrest procedures. In such procedures the officer begins by interviewing the suspect, proceeds to easily administered perfor-

mance tests, then administers the horizontal gaze nystagmus (provided that the officer is trained in administering this test). If at this point the officer feels relatively certain that the person may be intoxicated, he or she is transported to shore where balance tests can be administered.

Throughout the process the officer assesses the suspect's abilities and impairments and revises his or her estimate of the suspect's BAC. The intention was to replicate this process in this study.

2.1 Design

In order to determine the effectiveness of the field sobriety test battery in aiding the officers to identify subjects who are intoxicated (generally at or above 0.10% in most states), three experimental groups were dosed to reach target BAC levels and tested. Each of the three groups was composed of approximately one third of the 97 subjects.

	Subjects	Dose Range	Target BAC Level
Group A	32	0.10% to 0.14%	0.12%
Group B	33	0.06% to 0.10%	0.08%
Group C	32	0.00%	0.00%

In the original proposal for this study it was intended that the three groups would be further divided in half in order to test for an order-effect for the tests believed to be the least accurate (the Alphabet Recital, Thumb to Finger Count, Hand Pat, and Finger to Nose). The orders of testing for each half of the subjects was to vary slightly, i.e., the order of the four performance tests would be reversed and the order of the two balance tests would be reversed as follows:

ORDER 1 (49 Subjects)	ORDER 2 (48 Subjects)
Interrogation	Interrogation
Behavioral Observation	Behavioral Observation
1st BAC Estimate	1st BAC Estimate
Alphabet Recital	Thumb to Finger Count
Hand Pat	Finger to Nose
2nd BAC Estimate	2nd BAC Estimate
Finger to Nose	Hand Pat
Thumb to Finger Count	Alphabet Recital

3rd BAC Estimate	3rd BAC Estimate
Horizontal Gaze Nystagmus 4th BAC Estimate	Horizontal Gaze Nystagmus 4th BAC Estimate
On Land - HGN 5th BAC Estimate	On Land - HGN 5th BAC Estimate
On Land - Walk and Turn One Leg Stand 6th BAC Estimate	On Land - One Leg Stand Walk and Turn 6th BAC Estimate

However, difficulties arose in obtaining a firm commitment for the participation of all 96 subjects. The experimental design used required 96 subjects. When the study began it was uncertain whether enough subjects would participate and the decision was made to begin testing subjects using Order 1 only and abandon the effort to test for an order effect.

2.2. Field Sobriety Tests Used

Interrogation and Observation

During a routine OUI investigation, the initial contact which the officer has with the suspect provides a period for interrogation and observation. During the first few moments of contact, the officer engages the suspect in conversation in order to have an opportunity to observe the suspects ability to answer simple questions and to demonstrate orientation to person, time, and place.

While conducting the interrogation the officer makes observations regarding the subject's appearance and manner. Observations may include cues obtained through checking: clothes, breath, attitude, facial coloration, eyes, pupils, speech, unusual actions. Often officers in the field are not provided with a formal checklist of items, but rely on recall in making their observations.

In order to insure that both teams of officers conducted a similar observation process, a list of typical questions was provided from which the officer could conduct the interrogation process. Officers were instructed to phrase the questions in their own style so that language, and the situation in general, would not be awkward or stilted.

This list was extracted from the Ohio Department of Natural Resources, Division of Watercraft, "Alcohol Influence Report". Similar checklists are in use in California,

Maryland, and in several other states. Appendix, item 1 includes a copy of interrogation questions, observation checklist, and scoring sheets for all testing.

Alphabet Recital

The suspect is asked to recite the alphabet from A through Z. In some locales, officers ask the suspect to recite from the middle of the alphabet, specifying a letter to begin at, for example, "recite the alphabet starting from the letter J". This is done, since it requires more thinking on the part of the suspect and may show confusion and lack of reasoning on the part of the suspect. However, for purposes of the study, the suspect was asked to recite from A through Z. In some court proceedings judges have been known to consider mid-alphabet recital as an attempt by the officer to confuse the suspect. Therefore, the method most widely accepted in a court of law as evidence of possible intoxication was used in this study.

Hand Pat

The suspect is instructed to hold both palms out, facing up. The left hand is kept stationary while clapping the palms together. When the palm is struck the person counts ONE. He then turns the right hand over and claps the back side of the palm and counts TWO. The suspect continues to clap alternating palm and back side of palm and counting ONE, TWO. The suspect is asked to count out loud and to increase his speed clapping and counting.

Finger to Nose

The suspect is seated and asked to put his hands at his side. With eyes closed and head tilted back slightly, he is asked to touch the tip of his nose with the tip of his index finger. When the officer says RIGHT the person uses his right hand. When the officer says LEFT the suspect uses his left hand.

Finger Count

The suspect is asked to touch and count each finger in succession, counting aloud. He touches thumb to finger and counts the four fingers aloud 1-2-3-4 and then reverses counting 4-3-2-1. He is instructed that each time he counts he should try to go a little faster.

Horizontal Gaze Nystagmus (HGN)

This test measures the involuntary lateral jerking motion of the eyes. It occurs upon lateral gaze when BAC exceeds .06 (Burns and Moskowitz, 1977).

The suspect is asked to look at the tip of a pencil. Keeping his head still, he is asked to track the tip of the pencil with his eyes while the officer moves it.

Walk and Turn

This is a test of balance and was, therefore, given on land. It is also a test of the person's ability to follow simple instructions and to divide his attention between listening to the officer and maintaining a specific standing position.

The suspect is instructed to stand on a line with his right foot in front of the left. He is instructed that the right heel should touch his left toe.

The suspect is instructed to take NINE heel-to-toe steps down the line, turn around, and take NINE heel-to-toe steps back. In turning around, the suspect turns by pivoting on one foot. He is asked to keep the foot on the line and use the other foot to turn himself around with several small steps. Hands are kept at the sides at all times. The suspect is instructed to watch his feet at all times, and count the steps out loud.

One-Leg Stand

This is a test of balance and was, therefore, given on land. It is also a test of the suspect's ability to follow simple instructions.

The suspect is asked to stand with his heels together and his arms down at his sides. He is asked to raise one leg so that his heel is about six inches off the ground and to hold that position. While watching his raised foot the person is to count from 1001 to 1030.

2.3 Subjects and Raters

2.3.1. Subject Description

Ninety-seven subjects participated in the study. The subjects were all military personnel from various facilities in the Yorktown, VA. area. The majority of subjects were Coast Guard personnel from The Reserve Training Center (RTC) Yorktown, the site of the study. The remainder of subjects were from Coast Guard Fifth District, Marines from the Naval Weapons Station, and Army personnel from Fort Eustis.

Subjects participated on a voluntary basis. They were given a number to be used throughout the study and assured that all data would be confidential. Men between the ages of 21 to 42 were the participants. The rationale for concentrating testing on the male rather than a mixed male-female sample is explained below. The appendix, item 2 lists the age distribution for participants.

Subject Age
Range = 21 to 42 years
Mean = 27 years
Mode = 21 years (21% of all subjects)

In a review of arrest data for intoxicated boat operation for the two year period of 1985 and 1986 it was found that the over-whelming majority of arrests involved men within the age group of 21 to 40. This review of arrest records was initially performed for Task 2 of this project, which involved the identification of possible remote detection cues of intoxication. Arrest records were reviewed in the two states of Ohio and Maryland and two counties in California (San Joaquin County and Lake Shasta). Furthermore, in Task 1 of this project, Accident Reports of fatal boating accidents occurring in California and North Carolina (the two states which have kept the most complete records of fatal boating accidents) were reviewed. This data indicated that the majority of fatal boating accident victims were men.

2.3.2. Subject Screening

Screening was conducted by Dunlap and Associates. A notice was posted or appeared in the newsletter of the facilities from which subjects volunteered. Potential subjects were informed that this was a controlled study concerning the effects of alcohol on boaters. Male subjects between the ages of 21 to 50 were solicited. A sample announcement, which was printed in "Plan of the Day" (RTC Yorktown newsletter), appears in appendix, item 3.

Potential subjects were initially screened either on the telephone prior to participation or in-person immediately before participation. They were asked about their age, boating experience, susceptibility to seasickness, medical condition, and drinking history. The "Telephone Screening Instrument" appears in appendix, item 4. Based on answers to these questions, the person was selected or rejected for participation. If selected, an appointment was set for participation in the study.

During a face-to-face interview (either prior to the day of participation or immediately before participation) the subject completed an "Alcohol Questionnaire" (see appendix,

item 5). The results of this questionnaire were used by Dunlap and Associates in assigning subjects to one of the three dosing groups. This was done in order to appropriately assign drinkers in accordance with their drinking history and habits.

This instrument produces two scores. The first score is the sum of the response weights for Question 1 through 11, and reflects the quantity, frequency and circumstances of the subject's typical drinking situations. The second score is the sum of the response rates for Questions 12 through 19, and reflects the subject's manifestation of generally accepted indications of "heavy" drinking. Questions 12 through 19 were derived from the Michigan "Alcoholism Screening Test".

Previous applications of the instrument by Dunlap and Associates led to establishment of the following "heavy" drinker score threshold:

1. a score of 25 or more on Questions 1-11, irrespective of the score on Questions 12-19; or,

2. a score of 18-24 on Questions 1-11, provided that a positive score (1 or more) is obtained on Questions 12-19.

The questionnaire score criteria used for the assignment of subjects to the three groups is included in appendix, item 5.

2.3.3. Raters/Marine Law Enforcement Officers

Two marine law enforcement officers from Maryland Department of Natural Resources and four marine law enforcement officers from Ohio Department of Watercraft served as raters for the study. All officers were experienced in field sobriety testing and arrest procedures.

Officer experience in marine law enforcement ranged from four to fifteen years. The majority of officers had nine or more years of experience (only one officer had only four years of experience). All the officers had completed extensive training in field sobriety testing. They were experienced in the use of field sobriety testing and had specific certification in Horizontal Gaze Nystagmus. Five of the six officers worked primarily in the field, while one of the officers worked primarily in an administrative and training capacity. Specifics on each of the officers are listed in appendix, item 6, "Years of Experience in Marine Law Enforcement and OUI Arrest Experience of Officers".

2.4. Facilities and Equipment

Facilities and equipment were jointly provided by RTC Yorktown and TSC. RTC Yorktown provided the physical site for the study including the rooms used for subject preparation and recovery. TSC provided all breath testing equipment.

2.4.1. Study Site

Two rooms in the Gymnasium Complex at RTC Yorktown were used for briefing, dosing, and recovery of subjects. Room #1 was used for the medical screening of subjects which took place prior to dosing. It also housed the breath testing equipment and breath-technician, dosing apparatus and dosing-technician. Room #2 was the area in which the subjects drank their drinks. Cards, magazines, and movies were provided for their entertainment during dosing. This room was also used for recovery, i.e., after being tested subjects returned to this room while waiting for their BAC to be confirmed to be 0.00% prior to release.

Wormley Creek was the docking area from which the boats were launched and returned. Figure 1 depicts the waterfront area. This area is about half a mile from the Gymnasium Complex. Therefore, a van was used to transport subjects to the dock.

2.4.2. Boats

Motor boats in the 16 to 18 foot range were used to provide the 90 minute boat ride for each subject. These were boats rented from U.S. Army, Fort Eustis. This particular type and size of boat was used since "Boating Statistics 1986" compiled by the U.S. Coast Guard indicates that the majority of fatal recreational boating accidents occur in boats that are less than 26 feet long. In addition, the previously mentioned arrest data indicated the majority of OUI arrests to involve operators of boats in this type and size.

The boats used by the officers from which they conducted the on-water testing were 16 to 18 foot "Boston Whaler" type boats. They are typical of the boats they would usually be operating on patrol.

2.4.3. Dosing Schedule and Apparatus

Appendix, item 7, "Dosing Tasks" outlines the schedule followed for dosing subjects on each day. Some variations from the schedule occurred due to no-shows and late arrivals of subjects.

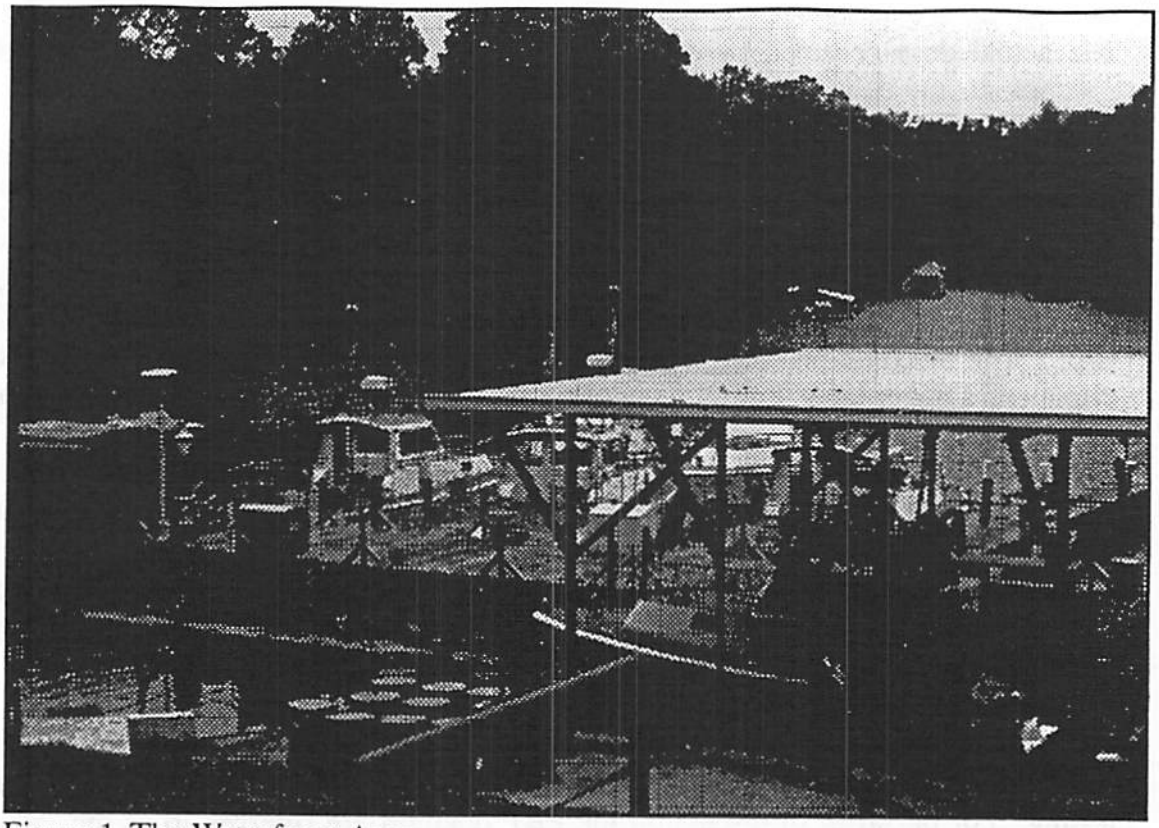


Figure 1. The Waterfront Area

Appendix, item 8 lists the "Nominal Dosing Levels" used for the subjects. Dosing was done with 190-proof (95%) grain alcohol. The drinks consisted of the appropriate alcohol dose and approximately 9 ounces of orange, grapefruit or tomato juice. The kind of juice used was dependent on the preference of the subject. For the Group C subjects (0.00% BAC), the drinks consisted of the preferred juice with approximately 4 milliliters of grain alcohol "floated" on top (i.e., the Group C subjects consumed a total of about 16 milliliters of grain alcohol over the four drinks served.) In no case did the Group C subjects register other than 0.00% on any of the breath tests given. In addition, no subject registered other than 0.00% on the first breath test of the day.

The actual doses given to the subjects varied somewhat from the nominal figures. Early on, the attempt was to "fine-tune" for the on the water testing. There were also variations in individual absorption rates due primarily to differences in stomach contents at the start of the dosing sessions. Although subjects were asked to eat only a "light" breakfast before arriving for participation in the study, some subjects did not comply. Dose levels were adjusted to attempt to compensate for such factors.

The actual dose received by each subject along with the subjects number, group assignment, and body weight are presented in appendix, item 9.

2.4.4. Breath Testing Equipment

Breath testing equipment was provided by TSC. All breath testing done on land, i.e., in the dosing area, was performed on the Seimens Alcomat. This highly accurate instrument uses an infrared absorption sensor. It provides a three-digit read-out of BAC. The machine provides a digital display on a small screen and also a printed display on a paper tape. For all on land breath testing there were two tests performed for each round of testing in order to insure the accuracy of the reading.

Breath testing done on the boat, prior to the officers beginning the field sobriety testing, was performed with the Alcometer S-D2, a product of Lion Laboratories, Ltd. This small, portable, hand-held, light-weight instrument uses a fuel cell sensor. It provides a modified three-digit display of BAC. The last digit is rounded to the closest 0 or 5 reading, for example, 0.054% is rounded to a reading of 0.055%.

In order to determine the accuracy of the rater's estimates of BAC these estimates were compared to the BAC readings taken with the Alcometer PBT prior to field sobriety testing. For purposes of discussion the PBT readings are referred to as the "actual BAC" even though they are really breath based estimates of arterial blood alcohol concentration.

The accuracy of the reading obtained from the fuel cell PBT reading was checked against the Gas Chromatograph. Each PBT reading was compared to the readings obtained through breath testing using the Seimens Alcomat. Each PBT reading was compared to the Alcomat reading taken prior to boarding the boat and the reading taken immediately upon return to the recovery area following field sobriety testing. In 96 of the 97 cases the readings from both instruments (PBT and Alcomat) were compatible. One reading on the PBT was unrealistically high, which may have been due to the subject belching and, therefore, elevating the PBT reading. In this one case the actual BAC was adjusted for the analysis, i.e., made consistent with the Alcomat readings.

Both types of instruments were used by trained study personnel and the BAC readings were not revealed to the officers or subjects throughout the testing day. Both types of instruments were calibrated at the begining of the experiment and after the first five days. Both instruments were used with a disposable mouth-piece for each subject.

2.4.5. Routine and Emergency Medical Personnel

Medical personnel were provided by RTC Yorktown in order to conduct a routine medical examination prior to each subject's participation in the study. Appendix, item 10 is a copy of the "Medical Report" form.

During the examination the following items were checked: pulse, blood pressure, temperature, respiration. The subject was also questioned regarding recent consumption of any prescribed or over-the-counter medication. Based on the results of this examination, the person would be certified as qualified or not qualified to participate in a controlled drinking study.

Throughout the study emergency medical assistance was on-call. RTC Yorktown has on-grounds medical facilities which were available for use in the event of illness or injury of any participant.

2.5. Preliminary Procedures

This section describes in detail the preliminary procedures followed before actual testing. These procedures include the establishment of a testing schedule, prerequisite environmental conditions under which testing could occur, instruction to subjects and officers regarding participation.

2.5.1. Testing Schedule

Two subjects were scheduled to arrive per hour. The first two subjects arrived at 07:00 hours. With this schedule up to fourteen subjects per day could be tested during daylight hours. The target number for subjects was twelve per day. Due to no-shows and cancellations, on several days less than twelve subjects were tested. Subsequently, on other days extra subjects were tested. The most subjects tested in one day was thirteen. All testing was completed within nine days.

2.5.2. Environmental Conditions

All testing was conducted from May 11 through May 21, 1987 on the James River in Yorktown, VA. Testing was conducted during relatively mild summer-like weather conditions. The intention was to conduct testing during the typical weather conditions experienced by the average recreational boater. Furthermore, "Coast Guard Boating Statistics" indicate that the majority of fatal boating accidents occur during daylight hours in calm waters, little or no wind, good visibility, and water temperature of 60 to 79 degrees fahrenheit.

No testing was conducted under adverse conditions, such as, high winds and disturbed sea state. On the average the temperature was approximately 80 to 85 degrees, ranging from 65 to 95 degrees. Testing was conducted on both sunny and cloudy days. Testing was also conducted under conditions of light rain. No testing was conducting during heavy rain. All testing was conducted during daylight hours.

2.5.3. Subject Briefing

Subjects were informed regarding the day's proceedings as soon as they arrived for participation ("Briefing Sheet", appendix, item 11). During the briefing subjects were asked to sign an "Informed Consent Form" (appendix, item 12). They were told that their participation would be for approximately seven or eight hours. They were told that a medical technician would be giving them a brief medical examination in order to certify that they were ready for participation.

Each subject was told that he would be expected to consume a glass of fruit juice with a measured amount of alcohol each 40 minutes until three glasses had been consumed. Before and after each drink he would be given a breath test. Following the third drink and breath test, he would be asked to board a boat for a 90 minute boat trip. During the trip he would be asked to consume a fourth drink. After the boat trip a breath test would be taken on the water and the subject's boat brought along side the officers' boat. The three police officers would then give the subjects standard field sobriety tests.

Subjects were instructed to act as if the situation was an actual encounter with a police officer and as if the person was indeed in danger of arrest. Subjects were instructed to perform as well as possible on each test. The seriousness of the scenario was emphasized. It was the job of the subject to convince the officers that he was sober.

Subjects were also informed that after testing they would receive a meal and periodic breath tests in order to monitor the elimination of alcohol from their bodies. When the alcohol content level was at 0.00% the subject would be released.

2.5.4. Officer/Rater Briefing

Prior to beginning on Day 1 the officers were trained in the use of the "Scoring Sheets". It was explained that the six officers would be working in two teams of three officers. Officers were designated as belonging to Team 1 (Rater #1, #2, #3) and Team 2 (Rater #1, #2, #3). Two subjects would be tested simultaneously, i.e., one being tested by each team.

Rater #1 from each team served as the lead-officer during the on-the-boat testing. Rater #1 would greet and question the suspect and give all instructions for The Alphabet Recital, Hand Pat, Finger to Nose, Finger Count. All three officers would be observing for the behavioral indicators of intoxication and would be observing the results of the tests given by the lead-officer. The HGN was to be given by all three officers, since this test requires a face-to-face position by each suspect and officer in order for the officer to make an accurate rating. Therefore, the lead-officer (Rater #1) would give the HGN, then Rater #2, and then Rater #3 would give the test.

For the on-the-land testing again each officer gave the HGN. Then Rater #2 from each team served as the lead-officer for the two on land tests: The Walk and Turn, and One-Leg Stand.

During the course of testing each officer was to make a BAC estimate after each test or pair of tests (as designated). With the results of each test the officer would have more information on the subject's abilities or level of impairment. Therefore, the BAC estimate may change as more information is received. Officers were instructed to make their estimates in accordance with their opinion at the moment, based on what they had seen thus far.

Officers were instructed to keep their scoring and BAC estimates confidential. They were not to look at each other's score sheets and were not to discuss their opinions on the subject's performance or BAC level. They were also cautioned to be mindful of their gestures and facial expressions and to guard against indicating their opinions in this manner. They were informed that an observer would be present at all times throughout testing in order to inform them of any cues which they may inadvertently be giving to each other.

2.6. Study Procedures

This section describes, in detail, the procedures experienced by the subjects and officers throughout their participation in the study. Procedures are discussed for: preparing subjects for dosing, dosing of subjects, exposing subjects to the marine environment, field sobriety testing on the boat and on land, and subject monitoring and release.

2.6.1 Subject Arrival, Briefing, and Medical Examination

As previously mentioned, subjects arrived in groups of two. Two subjects arrived each hour beginning at 07:00 through 12:00. Subjects were briefed regarding their participation in the study. Subjects completed the screening questionnaires (if not previously completed prior to the day of participation). The medical examination was given. Each

subject was then certified as ready or not ready for participation by the medical corpsman.

The dosing technician questioned the subject regarding what he had for breakfast in order to adjust the dose considering differences in absorption rates due to stomach content. Subjects had been asked to limit their breakfast to a "light meal" of toast or cereal. However, not all subjects adhered to the request and it was necessary to question them regarding their meal.

The dosing technician then mixed the drink in order to begin elevation or no elevation (for the placebo group) of the subject's BAC level in accordance with the subject's group assignment. Before giving the subject the first drink a breath sample was taken by the breath technician.

This process took approximately 30 minutes. For a subject arriving at 0700, he would be ready for dosing at 07:30.

2.6.2. Dosing on Land

The first drink was consumed during the first 20 to 30 minutes of the 40 minute period, then after waiting ten minutes a breath test was given. Throughout the study, the subjects did not drink or smoke for ten minutes prior to breath testing, since this would have interfered with a proper BAC reading. At no time prior to field sobriety testing did subjects consume food, since this would have affected the subject's alcohol absorption rate. Movies, magazines, and cards, were provided for the subjects to entertain themselves during dosing.

Drink #2 was given and consumed during the first 20 to 30 minutes of the next forty minute period. After waiting ten minutes a breath test was given. Drink #3 was given and consumed during the first 20 to 30 minutes of the next forty minute period. After waiting ten minutes a breath test was given.

Following the consumption of the three drinks, each subject was escorted to a boat. An escort accompanied the subject in order to insure his safety. The launching area was approximately a quarter-mile from the dosing area. The subjects were transported by van to Wormley Creek where they boarded a boat. Generally one subject rode on the boat with one boat operator and the escort. Due to periodic mechanical difficulty with some of the boats, at times two subjects rode in the same boat.

2.6.3. Dosing on the Boat

After the subject had been underway for approximately ten minutes he was given the fourth drink. This drink was pre-mixed by the dosing technician on shore and carried along by the escort.

2.6.4. Rendezvous with the Police Boat

After being underway for ninety minutes, the boat operators radioed the boat launch area to announce their approach. Each team of officers were waiting aboard a boat for one subject to test. One subject boat and one police boat were rafted together. (The two sets of subject and police boats were stationed approximately 100 to 200 yards from each other, i.e., a sufficient distance to insure non-interference.) The officers usually stayed in their boats (three in each boat) while the subjects stayed in their boat (one in each boat, accompanied by escort and operator). In the field officers usually conduct field sobriety testing from their own boats and do not board the suspect's boat unless necessary. The officer is at risk when he boards the suspect's boat. Figure 2 shows the position of boats during testing.

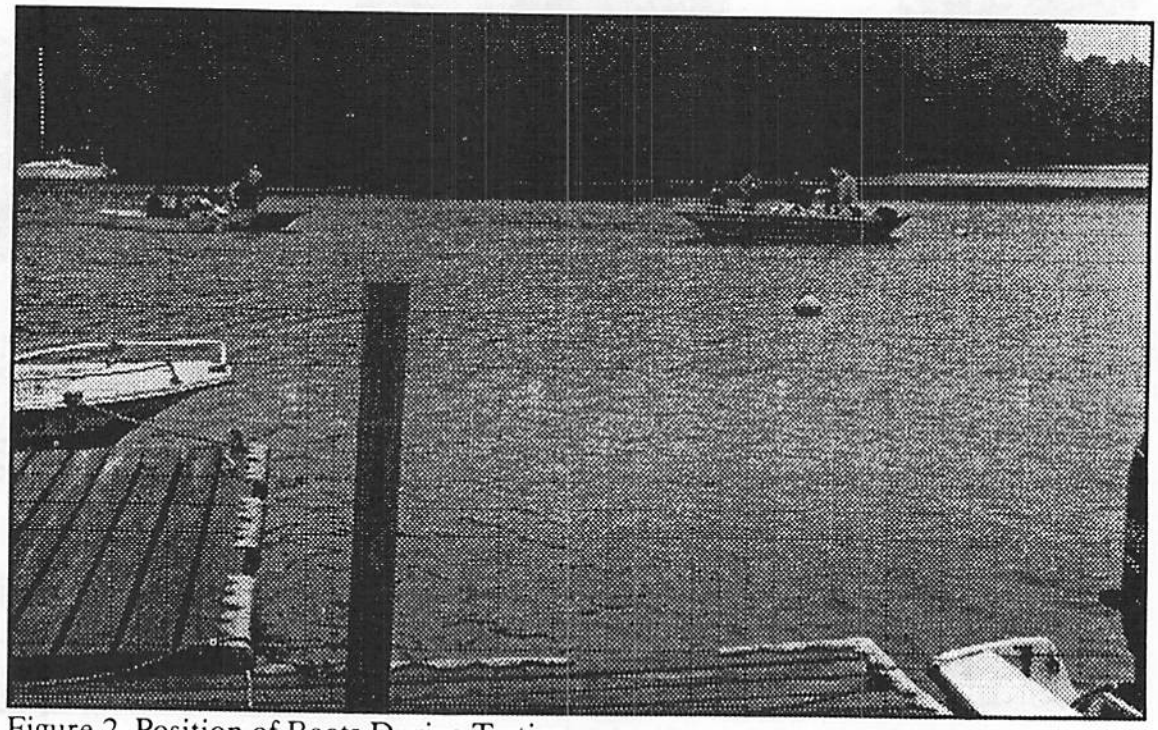


Figure 2. Position of Boats During Testing

2.6.5. Testing BAC on Boat

Before the officers began the interrogation, observation, and field sobriety testing, a BAC test was given to the subject by the researcher. The test was performed with the portable breath unit and the test results were kept secret from the subject and officers. Figure 3 depicts the breath testing. This test was performed in order to determine the subject's BAC level prior to testing so that, during data analysis, the officer's estimated BACs could be compared to the actual BAC. Figure 4 shows the BAC levels of the subjects measured on the boat immediately prior to FST. The BACs measured are found in Table 1.

2.6.6. Field Sobriety Testing on the Boat

The procedure described to the officers during the "Officer/Rater Briefing" was followed during the nine day testing period. Testing occurred as follows:

The lead officer (who was Rater #1) designated to perform the on boat testing began questioning the subject, using the "Interview" section of the scoring sheet as a model.

Figure 3. Breath Testing Prior to Field Sobriety Testing

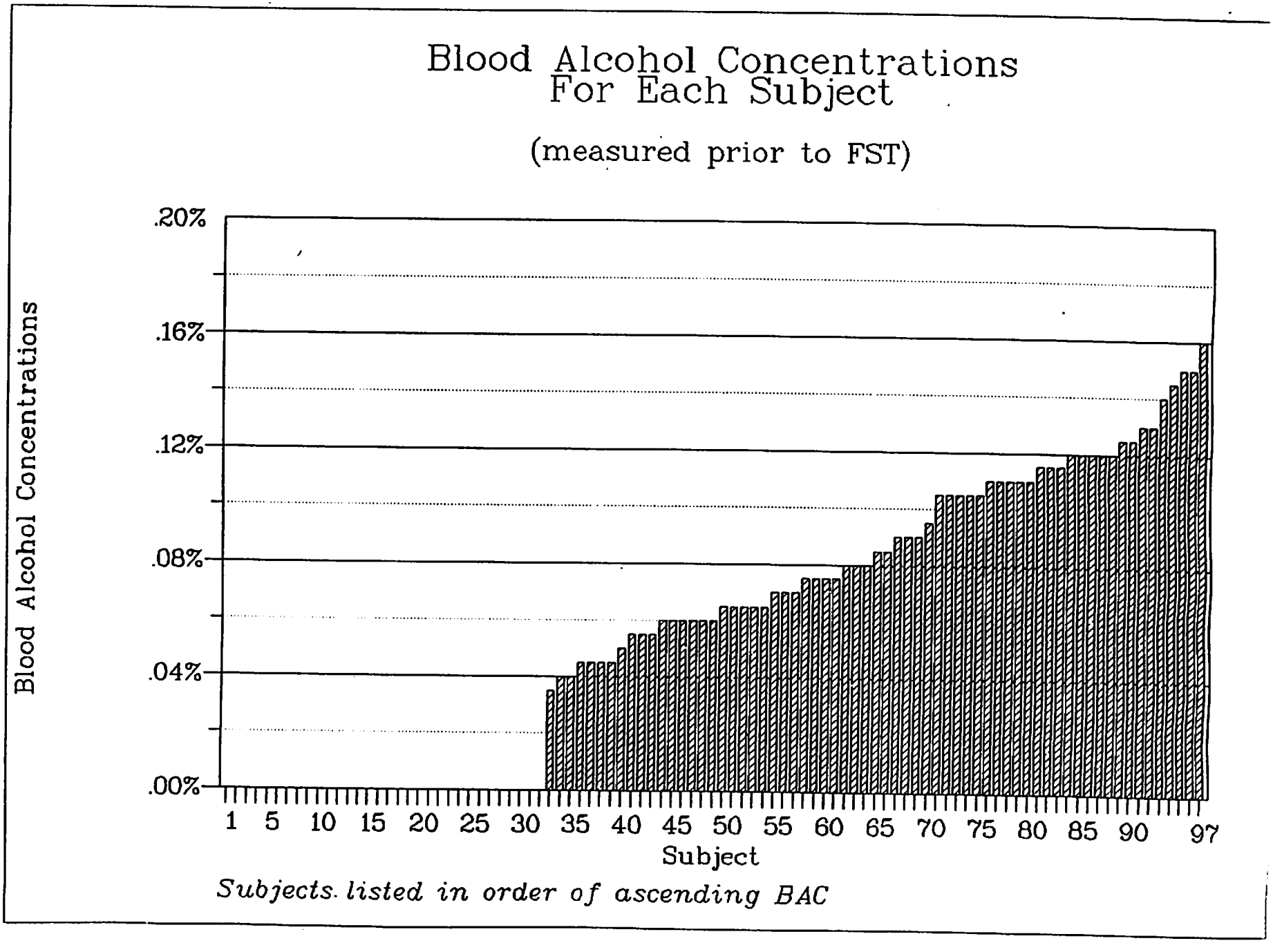

Blood Alcohol Concentrations
For Each Subject
(measured prior to FST)
Blood Alcohol Concentrations
.20%
.16%
.12%
.08%
.04%
.00%
1 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 97
Subject
Subjects listed in order of ascending BAC

Table 1

BACs MEASURED PRIOR TO FST

Subject # *	% BAC	Subject # *	% BAC
Subject 1	.00%	Subject 49	.07%
Subject 2	.00%	Subject 50	.07%
Subject 3	.00%	Subject 51	.07%
Subject 4	.00%	Subject 52	.07%
Subject 5	.00%	Subject 53	.07%
Subject 6	.00%	Subject 54	.07%
Subject 7	.00%	Subject 55	.07%
Subject 8	.00%	Subject 56	.07%
Subject 9	.00%	Subject 57	.08%
Subject 10	.00%	Subject 58	.08%
Subject 11	.00%	Subject 59	.08%
Subject 12	.00%	Subject 60	.08%
Subject 13	.00%	Subject 61	.08%
Subject 14	.00%	Subject 62	.08%
Subject 15	.00%	Subject 63	.08%
Subject 16	.00%	Subject 64	.09%
Subject 17	.00%	Subject 65	.09%
Subject 18	.00%	Subject 66	.09%
Subject 19	.00%	Subject 67	.09%
Subject 20	.00%	Subject 68	.09%
Subject 21	.00%	Subject 69	.10%
Subject 22	.00%	Subject 70	.11%
Subject 23	.00%	Subject 71	.11%
Subject 24	.00%	Subject 72	.11%
Subject 25	.00%	Subject 73	.11%
Subject 26	.00%	Subject 74	.11%
Subject 27	.00%	Subject 75	.11%
Subject 28	.00%	Subject 76	.11%
Subject 29	.00%	Subject 77	.11%
Subject 30	.00%	Subject 78	.11%
Subject 31	.00%	Subject 79	.11%
Subject 32	.00%	Subject 80	.11%
Subject 33	.04%	Subject 81	.12%
Subject 34	.04%	Subject 82	.12%
Subject 35	.04%	Subject 83	.12%
Subject 36	.05%	Subject 84	.12%
Subject 37	.05%	Subject 85	.12%
Subject 38	.05%	Subject 86	.12%
Subject 39	.05%	Subject 87	.12%
Subject 40	.05%	Subject 88	.12%
Subject 41	.06%	Subject 89	.13%
Subject 42	.06%	Subject 90	.13%
Subject 43	.06%	Subject 91	.13%
Subject 44	.06%	Subject 92	.13%
Subject 45	.06%	Subject 93	.14%
Subject 46	.06%	Subject 94	.15%
Subject 47	.06%	Subject 95	.15%
Subject 48	.06%	Subject 96	.15%
		Subject 97	.16%

* Subject numbers do not represent order of dosage

The officer phrased the questions in his own words. Meanwhile, the other two officers were listening and watching. All three officers made observations in accordance with the "Observation" section of the scoring sheet. Then each of the three officers made a BAC estimate on his or her scoring sheet. Each officer could not see the estimate of the other officers. Then Rater #1 began the field sobriety testing. The "Alphabet Recital" was given by Rater #1 and individually scored by each rater in confidence on his/her scoring sheet. The "Hand Pat" test was given by Rater #1 and individually scored by each officer in confidence on his or her scoring sheet. After these two tests had been given each rater wrote down a BAC estimate for the subject. This estimate was based on the information received thus far.

Then Rater #1 gave the subject the "Finger to Nose" test. Each rater individually scored the subject's performance. Rater #1 then gave the subject the "Finger Count" test and again each rater individually scored the subject's performance. After these two test had been given each rater wrote down a BAC estimate for the subject. This estimate was based on the information received thus far.

Rater #1 gave the HGN test (depicted in Figure 5) and rated performance and wrote down a BAC estimate. Then the other two officers in turn gave the HGN, rated performance, and wrote down a BAC estimate. Once again, this estimate was based on the information received thus far.

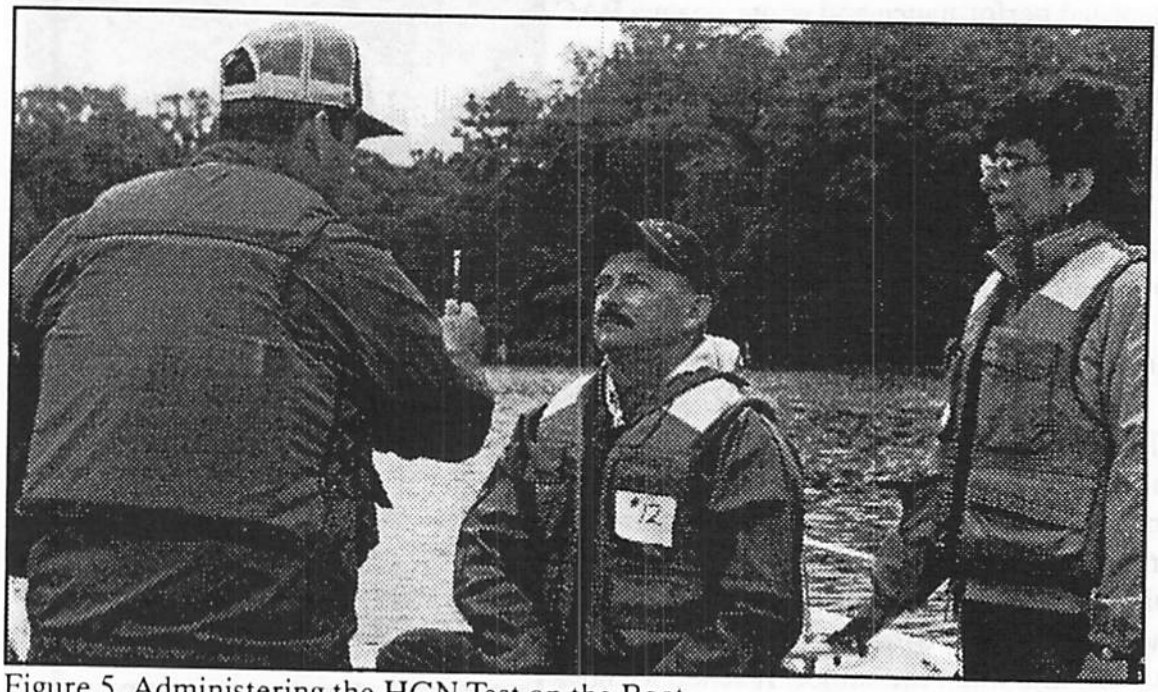


Figure 5. Administering the HGN Test on the Boat

At this point the subject was transported back to land. Testing continued on land after a brief hiatus, established to simulate the time which would be required to bring a suspect to shore in a real arrest. This wait did not significantly effect the subjects BAC.

2.6.7. Field Sobriety Testing on Land

Rater #2 in the team of three always served as the lead officer on land. This was done in order to reduce variance associated with subject exposure to different lead officers.

The lead officer on land gave the HGN, rated performance and gave a BAC estimate. Then the other two officers in turn did the same.

The subject was given ten minutes to attain "land-legs", i.e., stabilize balance in order to perform the balance tests to follow.

The lead officer gave the "Walk and Turn" test (depicted in Figure 6) while the other two raters observed. All three officers individually recorded performance and wrote down a BAC estimate. This estimate was based on the information received thus far. The lead officer gave the "One-Leg Stand" test while the other two officers observed. All three officers individually recorded performance and wrote down a BAC estimate. This estimate was based on the information received thus far.

Figure 6. Administering the Walk and Turn Test on Land

2.6.8. Monitor and Release of Subject

The subject was then transported by van back to the Recovery Area. A breath test was taken on the Seimens Alcomat in order to later confirm the reliability of the on boat BAC reading taken with the portable device. The subject was then given lunch. Breath tests were given periodically and when the subject reached a 0.00% BAC he was released.

2.6.9. Officer Debriefing and Feedback Sessions

Each evening, following the testing of the last two subjects, a debriefing session was held. Any logistical problems which had arisen during the day were discussed. The officers were told the actual BAC for each subject tested that day. This feedback regarding actual BAC is representative of realistic arrest procedures. In the field, after the suspect has been given a chemical BAC test, the officer is told the score by the testing technician.

3 ANALYSIS

As indicated in the "Methods" section, the raters estimated the subject's BAC immediately after administering the tests listed below. The "First" BAC estimate made by the rater was based on the information obtained from "Interview and Observation". The "Second" BAC estimate was based on the information from "Interview and Observation" and the additional information which may have been obtained from "Alphabet Recital" and Hand Pat". Each successive BAC estimate was based on the information from all tests given to that point in time. Therefore, this was an accumulative process. As each test was given the assumption was that the rater would be obtaining more information on which to base the next BAC estimate. By the "Sixth" BAC estimate the rater's estimate was based on all information provided by administering all tests. The "Sixth" estimate is, therefore, referred to as the "Final Cumulative Estimate", i.e., resulting from the accumulation of information obtained from administering all tests.

Tests Administered	BAC Estimates
Interview and Observation	First
Alphabet Recital and Hand Pat	Second
Finger to Nose and Finger Count	Third
Horizontal Gaze Nystagmus on Boat	Fourth
Horizontal Gaze Nystagmus on Land	Fifth
Walk and Turn, One Leg Stand	Sixth (Final Cumulative Estimate)

Data were analyzed for all 97 subjects. As indicated above, there were six BAC estimates made by each of the three officers assigned to evaluate the subject, with one exception. Due to mechanical difficulties with one of the boats, the on boat HGN could not be given to one subject. Therefore, all analysis represents results for 97 subjects for the first, second, third, fifth, and six estimate, and 96 subjects for the fourth estimate.

All BAC estimates of all raters were included in the data analysis, with one exception. One of the six raters (Team 1, Rater 3) was experienced in the administrative and training aspects of marine law enforcement, but did not have experience in the implementation of OUI arrest procedures in the field. (Appendix, item 6 includes a list of the experience of all raters.) This particular rater had no recent history of making arrests, while the other five officers had such OUI arrest experience. In examining the correlation between individual officer's final cumulative rating (BAC estimate given after administering all tests) and the BAC (as measured by PBT), it was found that this officer's first three days of performance in the study were very erratic. As the study progressed, performance for this officer improved dramatically. By Day 4 the correlation between the final cumulative rating and the measured BAC had stabilized.

Therefore the data analysis includes only those ratings provided by the officer after day three. Improvement was probably achieved through exposure to the testing in the field and the daily Feedback Session described above.

The analyses performed for this report provide three different measures of performance:

- Correlation between the officers' estimates of BAC and the measured BAC's;
- the absolute differences between the officers' estimates of BAC and the measured BACs; and
- the frequency with which the officers' estimates of BACs were correctly above the BAC which would result in conviction (True Arrest) or correctly below the BAC which would result in conviction (True Release).

In order to satisfy the basic goal of the study: to determine if use of FSTs on individuals exposed to a marine environment would reduce FST accuracy, the performance of the raters in this study was compared to the performance of similar raters in studies conducted in non-marine environments.

In prior non-marine studies of the effectiveness of FST's (Burns and Moskowitz,and Tharp, et al.) Pearson correlation coefficients were computed between the measured BACs and the BAC estimates of raters using FSTs. To determine if the accuracy of the raters in this study were consistent with prior studies, Correlation coefficients were computed between the measured BACs and the mean estimates of:

- both teams of raters, (the mean BAC estimates of the three team members for each of the two teams was compared with the measured BAC of subjects each team rated)
- each rater individually (the BAC estimates given by individual raters were compared with the measured BACs of the subjects rated)

Although the study's primary goal was to judge the relative accuracy of FSTs in marine and non-marine environments, the data gathered supported estimates of the absolute precision of the raters performance. This index of accuracy was the absolute deviation between the raters' BAC estimates and the measured BACs. This measure is more easily interpreted than the correlation and sensitive tests of the statistical significance of differences between the accuracy of different portions of the FST battery are available (Student's t test).

Finally, in order to predict how well a trained marine safety officer could use the BAC to discriminate legally intoxicated suspects from legally sober suspects "True Arrest" and "True Release" indices were developed by TSC. These indices describe the raters'

performances in determining whether a subject's BAC exceeded a set point. This procedure provides information on the probability that an officer will correctly discriminate between individuals who are legally intoxicated and those that are not. These "True Arrest" and "True Release" indices are valuable for illustrative purposes but are not parametric in nature and do not permit the use of sensitive statistical tests.

4.0 RESULTS

4.1 Correlations Between Estimates of Bac and Actual BAC

4.1.1 Overall Correlation Between Bac Estimates and Actual BAC

Figure 7 depicts the Pearson correlation coefficients (R's) calculated for all combined raters, i.e., estimates on all 97 subjects (each correlation represents the data of all subjects). It shows that in this study there was an increased correlation between the officers' estimates and the actual BAC as the officers proceeded from the first estimate through the sixth (final cumulative estimate). As more information on the subject's level of impairment became apparent through administration of the tests, the officers' estimates more closely approximated the actual BAC.

While the methodology used by Burns and Moskowitz, (op.cit.) is not completely comparable it is interesting to note that the mean correlation for all raters between measured BAC and the final cumulative rating was .704 and the value found by Burns and Moskowitz, (op.cit.) was .669.

4.1.2 Correlation Between Individual Rater's Estimates and Actual BACs

As an aid in examining the performance of each rater and the ability of the field sobriety test battery to improve the individual rater's estimates, Table 2 lists the correlations between individual rater's estimates and actual BAC. These correlations are depicted graphically in Figure 8.

4.2 Tests of Absolute Difference Between Estimated Bacs and Actual BACs

The absolute deviation between the BAC estimate and the actual BAC is expressed as a % BAC. A highly accurate rater's estimates on the average differed from the actual BACs by 0.023% BAC and a less accurate rater's estimate differed by 0.074% BAC. For example, a highly accurate rater's estimate might be 0.080% BAC when the actual BAC is 0.103%, (a difference of 0.023% between the estimate and the actual BAC). Paired t tests were used to determine if the differences of the absolute values of the differences between PBT measured BACs and officers' estimates of BAC at the different stages in the FST procedure could have been attributed to chance factors during the data collection. This hypothesis is known as the null hypothesis. The alternative hypothesis would imply that the differences observed in the study are likely to be found in real world applications of the portions of the FSTs. A t value implies a corresponding probability (P) value.

Figure 7

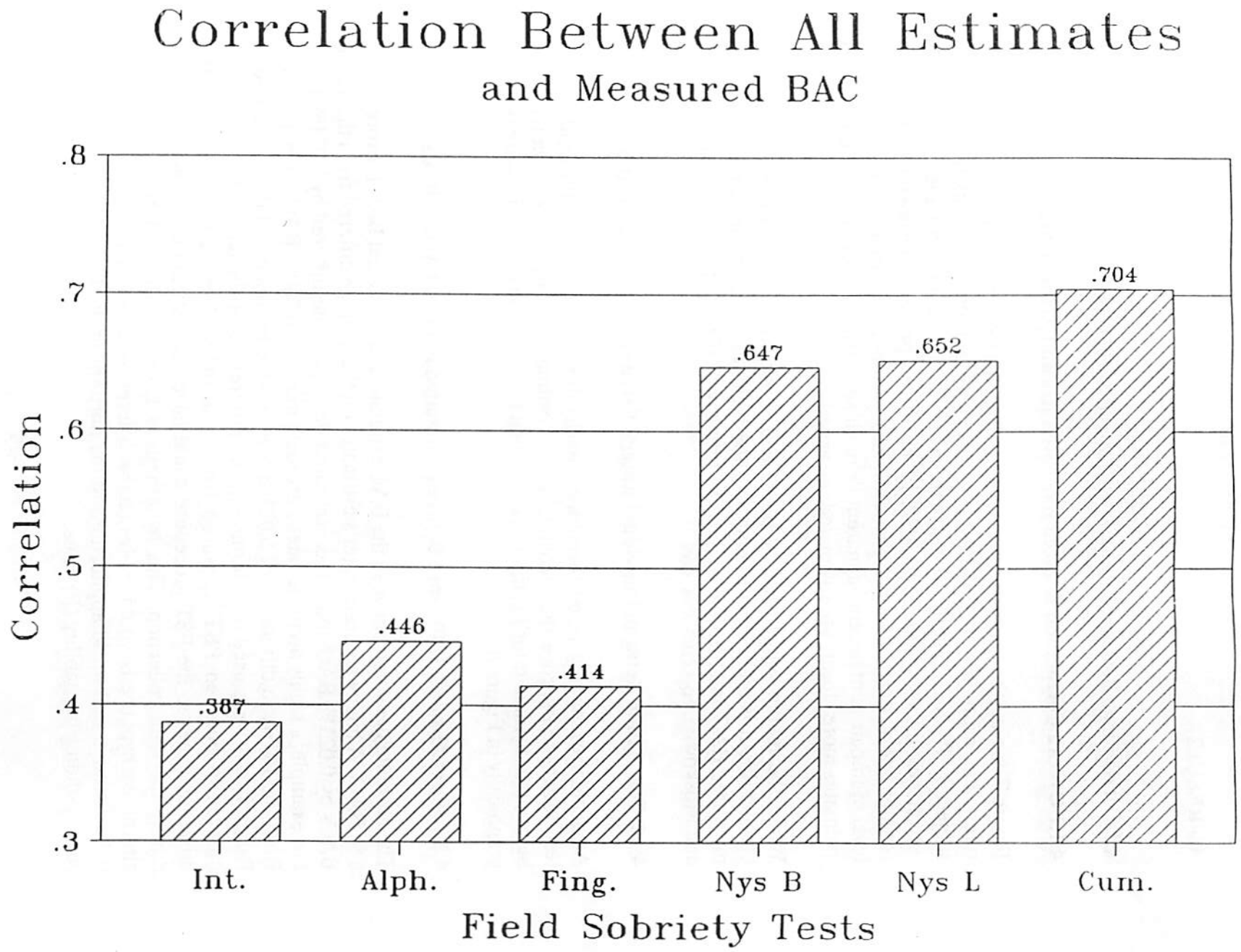
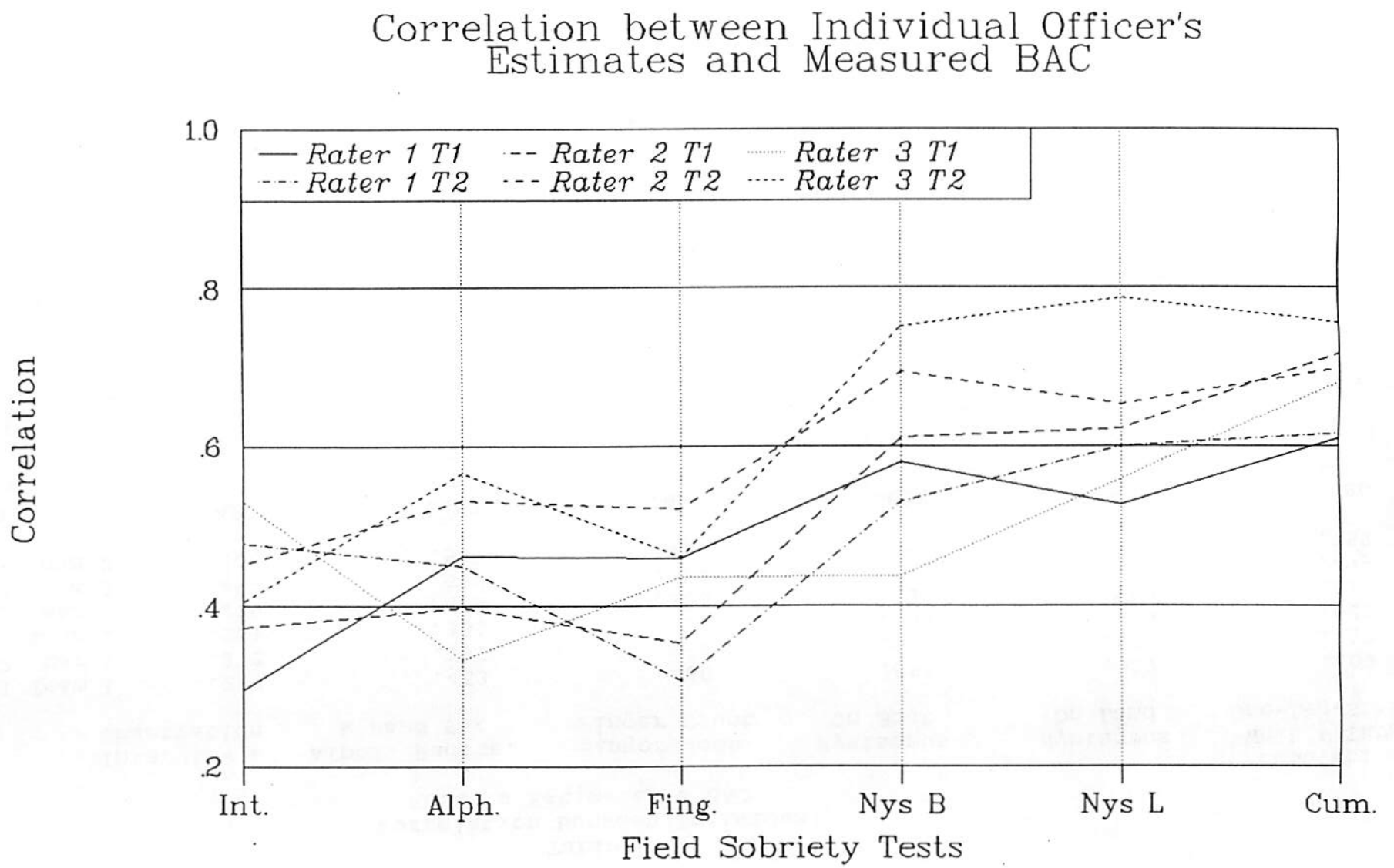

Correlation Between All Estimates
and Measured BAC
.8
.7
.6
.5
.4
.3
Correlation
.387
.446
.414
.647
.652
.704
Int.
Alph.
Fing.
Nys B
Nys L
Cum.
Field Sobriety Tests

Table 2
Correlation Between Individual
Rater's Estimates & BAC

	Interview & Observation	Alpha. Recite. & Hand Pat	Finger Nose Finger Count	Nystagmus On Boat	Nystagmus On Land	Cumulativ Walk & Tur One-Leg-Sta
Rater 1 Team 1	.294	.463	.460	.581	.527	.609
Rater 2 Team 1	.373	.397	.353	.612	.623	.717
Rater 3 Team 1	.531	.331	.436	.438	.559	.681
Rater 1 Team 2	.479	.449	.306	.531	.599	.616
Rater 2 Team 2	.452	.532	.522	.695	.654	.699
Rater 3 Team 2	.406	.567	.461	.752	.787	.757
Mean R	.423	.457	.423	.602	.625	.680

Figure 8


Correlation between Individual Officer's Estimates and Measured BAC
Rater 1 T1
Rater 2 T1
Rater 3 T1
Rater 1 T2
Rater 2 T2
Rater 3 T2
1.0
.8
.6
.4
.2
Correlation
Int.
Alph.
Fing.
Nys B
Nys L
Cum.
Field Sobriety Tests

This P value is the likelihood or probability that the observed results would occur if the null hypothesis were true (the differences found between two phases of the FST could have occured through chance variation rather than some quality of the test). To determine if the accuracy of the estimates of BAC, averaged over all raters, differed significantly between the first estimate (absolute deviation = 0.047% BAC) which was based on interview and observation and the last estimate (absolute deviation = 0.027% BAC) which was based on the entire field sobriety test battery, a paired t test was performed. The results of the t test indicated that the difference in accuracy was statistically significant and had a probability of being due to chance of less than 0.001% (t = -4.19). Therefore, the raters' estimates of BAC using the FST were significantly improved over those achieved based on observation and interrogation.

In order to determine if there was an overall improvement in accuracy between the on boat nystagmus test and the on land cumulative estimate a t test was performed. The accuracy of the estimated BACs of all raters combined did not differ significantly from the fourth estimate 0.029% BAC (Gaze Nystagmus on boat) to the last estimate based on the entire field sobriety test battery, including on-land testing 0.027% BAC (t = -1.32). Therefore, it would seem that on the whole, the small improvement in accuracy between the estimate following the on boat HGN and the cumulative estimate was not statistically significant. The group of officers did not improve the accuracy of their estimates, as a result of the on-land testing.

Table 3 represents the mean absolute differences between estimated and measured BAC for each rater for the first, fourth, and sixth estimates.

Table 3. Mean Absolute Differences Between Estimated and Measured Bac

	Obs.& Inter.	On Boat Nys.	Cum.
Rater 1 T1	0.052%	0.034%	0.040%
Rater 2 T1	0.043%	0.035%	0.030%
Rater 3 T1	0.083%	0.078%	0.070%
Rater 1 T2	0.047%	0.032%	0.028%
Rater 2 T2	0.050%	0.026%	0.025%
Rater 3 T2	0.052%	0.023%	0.023%

To determine which of the improvements in the individual rater's estimates between the first and last estimates was statistically significant, two sided t tests were performed. A probability of $P < .05$ indicates that a less than 5 in 100 probability exists that the change in estimate occurred by chance. A probability of $P < .01$ indicates that a less than 1 in 100 probability exists that the change in estimate occurred by chance. A probability of $P < .001$ indicates that a less than 1 in 1000 probability exists that the

change in estimate occurred by chance. If the P value is very small it is to be concluded that the BAC's are more correctly estimated after the test with the smaller absolute deviation. Large P values indicate that the size of the absolute deviation is due to chance.

Team 1	t value
Rater 1	-1.49
Rater 2	-2.34[1]
Rater 3	-1.44
Team 2	
Rater 1	-3.54[3]
Rater 2	-4.33[3]
Rater 3	-4.69[3]

Although all of the raters improved the accuracy of their estimates the improvements in raters 1 and 3 on team 1 were not statistically significant.

In order to determine if the improvement in individual rater's estimates between the observation based estimate and the on boat nystagmus based estimates were attributable chance t tests were performed. The differences between the first estimate of BAC and the fourth estimate of BAC indicated:

Team 1	t value
Rater 1	-2.78[1]
Rater 2	-1.21
Rater 3	-0.20
Team 2	
Rater 1	-3.25[2]
Rater 2	-4.35[3]
Rater 3	-4.93[3]

Although all of the raters improved the accuracy of their estimates, the improvements in raters 2 and 3 on team 1 were not statistically significant.

To determine if the improvement in each of the individual rater's estimates between on boat testing and the cumulative estimate was statistically significant, t tests were

[1] $P < 0.05$
[2] $P < 0.01$
[3] $P < 0.001$

performed. The differences between the fourth estimate of BAC and the sixth estimate of BAC indicated:

Team 1	t value
Rater 1	1.68
Rater 2	-2.66[2]
Rater 3	-2.03[1]
Team 2	
Rater 1	-1.76
Rater 2	-0.44
Rater 3	0.00

Only two of the six raters demonstrated a significant improvement ($p < 0.05\%$) in estimating BAC from the fourth (on-boat) to the sixth (on-land) estimate (Team 1, Rater 2 and 3). It should be noted that improvements in accuracy observed between test one and test four by these two raters were not statistically significant.

In summary, the results indicate that the accuracy of the officers to estimate BAC was significantly improved by use of the FST battery. The greatest amount of improvement in estimating BAC occurred at the fourth estimate, i.e., following the on boat testing. Small but statistically significant improvements in estimating BAC were evident for two of the six raters between the on-boat and on-land testing, suggesting that the addition of on-land testing may be beneficial to some officers.

Regarding the use of the HGN both on the boat and on land, it was found that on the boat the HGN contributed to a significant improvement in the estimates of the raters. However, administering the HGN a second time, i.e., on land, did not result in a significant improvement in the overall accuracy of the raters. In some states the HGN is administered twice, once on the boat and once on land, in order to give the suspect the benefit of the doubt. For example, in the court situation the defense might claim that the results of the HGN on the boat are not admissible as evidence, since the officer's scoring or the suspect's performance may have been adversely affected by the motion of the boat. The HGN was, therefore, given twice in this study in order to determine if there was a significant improvement in the raters' estimates attributable to administering the HGN a second time, but this time on land. No significant change in the officers' estimates occurred. Therefore, the results of this study indicate that it is not necessary to administer the test again on land in order to improve the accuracy

[1] $P < 0.05$
[2] $P < 0.01$
[3] $P < 0.001$

of estimate provided by the HGN. However, because the on-land HGN test did not result in a decrease in accuracy an officer might want to give the HGN again on land (following on boat HGN) in order to support (substantiate in court) the HGN results obtained on the boat.

4.3 Arrest/Release Decision

While the correlation between the estimates achieved using the FSTs and the PBT indicate overall accuracy, a more practical question is how well did the use of the FST procedures aid the officers in making correct decisions to arrest or release subjects at specified criteria levels of arrest and conviction?

In order to explore use of the field sobriety tests in making arrest/release decisions indices of discrimination were prepared. These indices describe how well an officer can estimate whether an individual's BAC is greater than or less than a set criterion. Two main indices were used: the "True Arrest Index" (TAI) and the "True Release Index" (TRI). The compliment of these indices are the "False Arrest Index" (FAI) and the "False Release Index" (FRI).

These terms are defined as:

> True Arrest Index - the proportion of individuals with BACs greater than or equal to a set criteria, who were judged by the rater as having BACs greater than or equal to that criteria.
>
> False Release Index - the proportion of individuals with BACs greater than a certain criteria, who were judged by the rater as having BACs less than that criteria.
>
> False Arrest Index - the proportion of individuals with BACs less than a set criteria, who were judged by the rater as having BACs greater than or equal to that criteria.
>
> True Release Index - the proportion of individuals with BACs less than a certain criteria, who were judged by the rater as having BACs less than that criteria.

The true arrest index and the false release index sum to 100% of all subjects with BACs at or above the set convict point criteria and similarly the true release index and false arrest index sum to 100% of all subjects below the convict point. In calculating these indices, the BAC estimates of the three raters estimating each individual subject's BAC were summed and divided by three in order to obtain a mean estimate for each subject

rather than determining the true release and true arrest index for each rater and averaging the indices over each team. This technique was used because the BAC estimates meet the requirements for parametric analysis while the arrest data do not.

In order to determine if the officers' true arrest and true release indices improved with different criteria the following BACs were used to compute the indices: 0.08%, 0.10%, and 0.12%.

Indices were computed to simulate the following conditions (these indices are found in tables 4a,b,c,d,e):

1. identification of all individuals with BACs equal to or greater than 0.10% when the conviction criteria is equal to or greater than 0.10%. (table 4a)

2. identification of all individuals with BACs equal to or greater than 0.08% when the conviction criteria is equal to or greater than 0.08%. (table 4b)

3. conservative identification of all individuals with BACs equal to or greater than 0.10% by arresting only individuals who were estimated to have BACs equal to or greater than 0.12%. (table 4c)

4. conservative identification of all individuals with BACs equal to or greater than 0.08% by arresting only individuals who were estimated to have BACs equal to or greater than 0.10%. (table 4e)

5. liberal identification of all individuals with BACs equal to or greater than 0.10% by arresting individuals who were estimated to have BACs equal to or greater than 0.08%. (table 4e)

4.3.1 Criteria for Arrest at > =0.10% (equal to or greater than 0.10%) Criteria for Conviction at > =0.10%

Figure 9 depicts the decision indices (percentage of correct decisions based on team averages) for the scenario in which the conviction criteria was equal to or greater than 0.10% and the officers' criteria for arrest was equal to or greater than 0.10% (condition 1).

Table 4a lists the overall arrest/release decisions aggregated over all teams for each of the six estimates of BAC under condition 1. By the last BAC estimate (following administering the entire test battery) the officers would have arrested 75% of the subjects having

Arrest BAC>=0.10%, Convict BAC>=0.10%

Decision Type	Interview & Observation	Alpha. Recite. & Hand Pat	Finger Nose Finger Count	Nystagmus On Boat	Nystagmus On Land	Cumulative Walk & Turn One-Leg-Stand
True Arrest	3.57%	3.57%	7.14%	51.85%	64.29%	75.00%
True Release	100.00%	100.00%	100.00%	94.20%	85.51%	85.51%
All Subjects	97	97	97	96	97	97
Subs >= 0.10%	28	28	28	27	28	28

Table 4b

Overall Arrest / Release Decision Estimates
Arrest BAC>=0.08%, Convict BAC>=0.08%

Decision Type	Interview & Observation	Alpha. Recite. & Hand Pat	Finger Nose Finger Count	Nystagmus On Boat	Nystagmus On Land	Cumulative Walk & Turn One-Leg-Stand
True Arrest	8.11%	24.32%	24.32%	69.44%	81.08%	86.49%
True Release	98.33%	98.33%	96.67%	85.00%	81.67%	80.00%
All Subjects	97	97	97	96	97	97
Subs >=0.08%	37	37	37	36	37	37

Table 4c

Overall Arrest / Release Decision Estimates
Arrest BAC>=0.12%, Convict BAC>=0.10%

Decision Type	Interview & Observation	Alpha. Recite. & Hand Pat	Finger Nose Finger Count	Nystagmus On Boat	Nystagmus On Land	Cumulative Walk & Turn One-Leg-Stand
True Arrest	.00%	.00%	.00%	11.11%	21.43%	39.29%
True Release	100.00%	100.00%	100.00%	100.00%	97.10%	97.10%
All Subjects	97	97	97	96	97	97
Subs >= 0.10%	28	28	28	27	28	28

Table 4d

Overall Arrest / Release Decision Estimates
Arrest BAC>=0.10%, Convict BAC>=0.08%

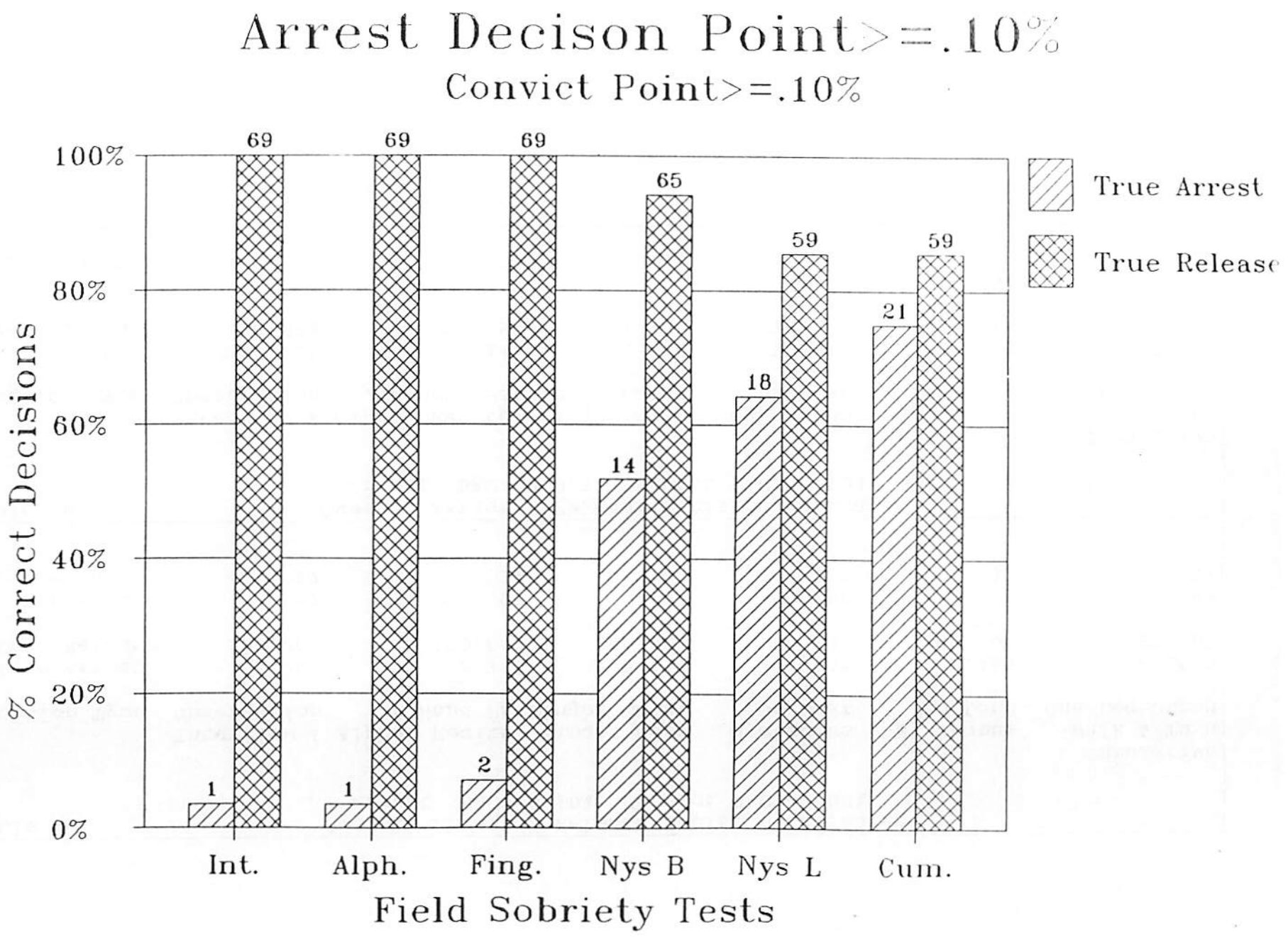
Decision Type	Interview & Observation	Alpha. Recite. & Hand Pat	Finger Nose Finger Count	Nystagmus On Boat	Nystagmus On Land	Cumulative Walk & Turn One-Leg-Stand
% True Arrest	2.70%	2.70%	5.41%	44.44%	59.46%	67.57%
% True Release	100.00%	100.00%	100.00%	96.67%	90.00%	90.00%
All Subjects	97	97	97	96	97	97
Subs >=0.08%	37	37	37	36	37	37

Table 4e

Overall Arrest / Release Decision Estimates
Arrest BAC>=0.08%, Convict BAC>=0.10%

Decision Type	Interview & Observation	Alpha. Recite. & Hand Pat	Finger Nose Finger Count	Nystagmus On Boat	Nystagmus On Land	Cumulative Walk & Turn One-Leg-Stand
True Arrest	10.71%	32.14%	32.14%	70.37%	82.14%	89.29%
True Release	98.55%	98.55%	97.10%	78.26%	73.91%	72.46%
All Subjects	97	97	97	96	97	97
Subs >= 0.10%	28	28	28	27	28	28

Figure 9


Arrest Decison Point>=.10%
Convict Point>=.10%
100%
80%
60%
40%
20%
0%
% Correct Decisions
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True Arrest
True Release
Int.
Alph.
Fing.
Nys B
Nys L
Cum.
Field Sobriety Tests

BACs of equal to or greater than 0.10% and would have falsely released 25% of the subjects having BACs of equal to or greater than 0.10%, i.e., estimating that their BACs were less than 0.10%. The officers would have correctly released 86% of the subjects having BACs less than 0.10% and would have falsely arrested 14% of the subjects having BACs less than 0.10%.

In the two previously mentioned studies of field sobriety testing in the highway situation (Burns and Moskowitz and Tharp, Burns, and Moskowitz), the total number of correct arrest/release decisions made by the officers was 76% and 81%, respectively. For purposes of comparison, the percentage for the total number of correct decisions was computed for the current study. Of 97 subjects, the officers correctly classified 21 true arrests (persons with BAC $>=0.10\%$) and 59 true releases (persons with BAC $<.10\%$). This represents 80 correct classifications out of 97, i.e., 82% correct decisions. Table 5 lists the data used in this calculation.

Table 5. Decision Index for All Raters' Estimates of BAC

	Arrests	Releases	All
Number of Decisions	True Arrests 21	True Releases 59	True Decisions 80
Number of Decisions	False Arrests 10	False Releases 7	False Decisions 17
Number of Decisions	All Arrests 31	All Releases 66	All Decisions 97

Percent of All Correct Decisions = 82%

These results were achieved through use of the entire field sobriety test battery, i.e., all on-boat and on-land tests. This battery includes the three tests which were found to be

the "best abbreviated battery" of field sobriety tests which were studied for use in the highway situation and additional FSTs used in the marine environment.

In the 1977 Burns and Moskowitz (B.&M.) study of "Psychophysical Tests for DWI Arrests", they found that at the 0.10% criteria the officers correctly decided to arrest 84% of the cases having BACs equal to or greater than 0.10%, and for less than 0.10% they made the correct decision to release 73% of the time. By computing the mean of all correct decisions made by the officers, it was found that the officers made correct decisions in 76% of all decisions made, i.e., correctly classifying 76% of the subjects with regard to a BAC of 0.10%.

In the 1981 Tharp, Burns, and Moskowitz (T.,B.&M) study of "Development and Field Test of Psychophysical Tests for DWI Arrest", they found that at the 0.10% criteria the officers correctly decided to arrest 64% of the cases having BACs equal to or greater than 0.10%, and for less than 0.10% they made the correct decision to release 88% of the time. By computing the mean of all correct decisions made by the officers, it was found that the officers made correct decisions in 81% of all decisions made, i.e., correctly classifying 81% of the subjects in regard to BAC of 0.10%. The results of the current (Yorktown) study are compatible with the findings of the two previously mentioned studies by Burns and Moskowitz, and Tharp, et al. The Table 6 summarizes the findings of the three studies.

Table 6. Comparison of Marine and Non-marine FST Indices

	Nys.B.	Cum.	B. & M.	T.,B.& M.
True Arrest Index	52%	75%	84%	64%
False Release Index	48%	25%	16%	36%
True Release Index	94%	86%	73%	88%
False Arrest Index	06%	14%	27%	12%

In addition to comparing the three studies with regard to percentage of correct decisions made by the raters, a comparison was made of the Arrest Error Rate. The Arrest Error Rate was calculated in order to compare this work with the two earlier studies mentioned. However, the particular values found may not hold in real world settings. The Arrest Error Rate is the number of false arrests divided by the number of total arrests. While the False Arrest Index identifies the percentage of subjects who had BACs of less than a set criteria but were judged by the rater as having BACs greater than or equal to that criteria, the Arrest Error Rate identifies the percentage of subjects erroneously arrested based on all subjects arrested.

The Arrest Error Rates of the raters of the three studies are listed in table 7.

Table 7. Arrest Error Rates

Study	False Arrests/Total Arrests	Arrest Error Rate
Yorktown	10 out of 31	32%
B. & M. (1977)	47 out of 101	46%
T.,B.& M. (1981)	38 out of 118	32%

The results of the current study are consistent with the findings of the two previously mentioned studies by Burns and Moskowitz, and Tharp, et al. In the Burns and Moskowitz study the high Arrest Error Rate was attributed to the fact that this was a laboratory study and was not indicative of the real arrest situation in the field. They stated that, officers in the field are reluctant to err in the direction of false arrests, and observations indicate that the most common error probably is a "false negative". A "false negative" refers to the situation in which an individual's actual BAC is equal to or above a set criteria and the officer estimates that the BAC is less than the set criteria. This would result in the officer releasing the suspect who was "legally" intoxicated. The officers in the Yorktown Study confirmed the prevalence of this type of decision-making. Basically, when in doubt, the officer would rather err in the direction of releasing a guilty person rather than arrest an innocent person.

In both the Tharp, et al. study and the Yorktown Study the Arrest Error Rate was 32%. While this is lower than the earlier Burns and Moskowitz findings, an Arrest Error Rate of 32% is quite high. It essentially means that the officers would have arrested one innocent person in every three arrests. It is believed that this high Arrest Error Rate is due to the fact that the officers may have decided to arrest a greater number of individuals than they would have arrested in the field, since these "arrests" were not actual arrests but were part of an experimental study. Since there was no consequence for either the officer or the subject, as a result of an erroneous decision to arrest, the officers may have been inclined to decide to arrest rather than to release. In the field this would not be the situation and fewer arrest errors would occur.

It should also be noted that in the present study, the decision to arrest cannot be directly projected to actual performance, because none of the subjects reached very high BACs (0.16%) the officers' decision processes were made slightly more difficult. In actual patrols officers will encounter a small number of extremely intoxicated individuals. These individuals are presumably more readily detected as intoxicated. Therefore, under actual conditions the officer's decisions regarding arrest may be improved.

4.3.2 Criteria for Arrest at > =0.08% Criteria for Conviction at > =0.08%

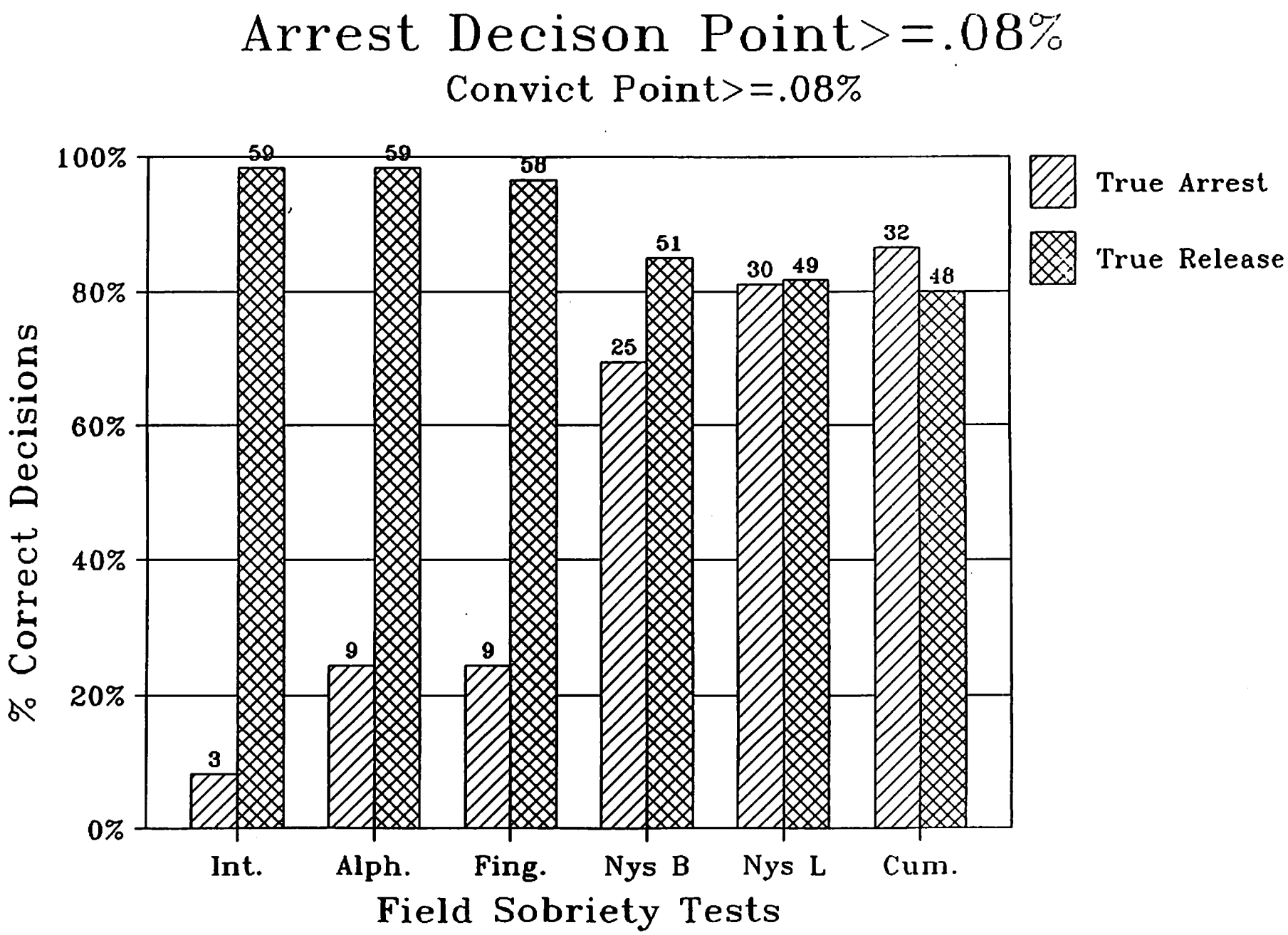
Figure 10 depicts the decision indices for the scenario in which the conviction criteria was equal to or greater than 0.08% and the officers' criteria for arrest was equal to or greater than 0.08%. Table 4b lists the overall arrest/release decisions for all officers for each of the six estimates of BAC. By the last BAC estimate (following administering the entire test battery) the officers would have arrested 86% of the subjects having BACs equal to or greater than 0.08%, Inversely, the officers would have falsely released 14% of the subjects having BACs equal to or greater than 0.08%. The officers would have correctly released 80% of the subjects having BACs less than 0.08%. Inversely, the officers would have falsely arrested 20% of the subjects having BACs less than 0.08%. It follows logically that if a lower arrest/conviction criteria is set, more subjects are subsequently arrested, however, it is at the cost of a greater number of false arrests.

4.3.3 Criteria for Arrest at> =0.12% Criteria for Conviction at > =0.10%

Figure 11 depicts the decision indices for the scenario in which the conviction criteria was equal to or greater than 0.10% and the officers' criteria for arrest was equal to or greater than 0.12%. Table 4c lists the overall arrest/release decisions for all officers for each of the six estimates of BAC. This scenario represents a situation in which the officer is being conservative in making the decision to arrest. Often officers in the field will make such a decision in order to increase the probability of a true arrest and decrease the probability of a false arrest. Officers often arrest at an estimated BAC which exceeds the BAC needed for conviction, since a significant amount time is lost in transporting the suspect to the site of the breathalizer unit. During this transport time the suspect's BAC level can decrease, for example, approximately 0.015% per hour elimination rate dependent on rate of absorption and body weight. Therefore, the officer feels more confident when arresting the suspect who is estimated to be 0.02% above the conviction criteria.

In this scenario, by the last BAC estimate (following administration of the entire test battery) the officers would have arrested 39% of the subjects having BACs equal to or greater than 0.10%. Inversely, the officers would have falsely released 61% of the subjects having BACs equal to or greater than 0.10%, i.e., estimating that their BACs were less than 0.10%. The officers would have correctly released 97% of the subjects having BACs less than 0.10%. Inversely, the officers would have falsely arrested 3% of the subjects having BACs less than 0.10%. Logically, since the officers are being more conservative in their decisions to arrest, many fewer subjects would have been arrested than in the two previous scenarios, i.e., 39%. When being conservative the officers indeed make fewer arrests, however, the benefit appears in

Figure 10


Arrest Decison Point>=.08%
Convict Point>=.08%
100%
80%
60%
40%
20%
0%
% Correct Decisions
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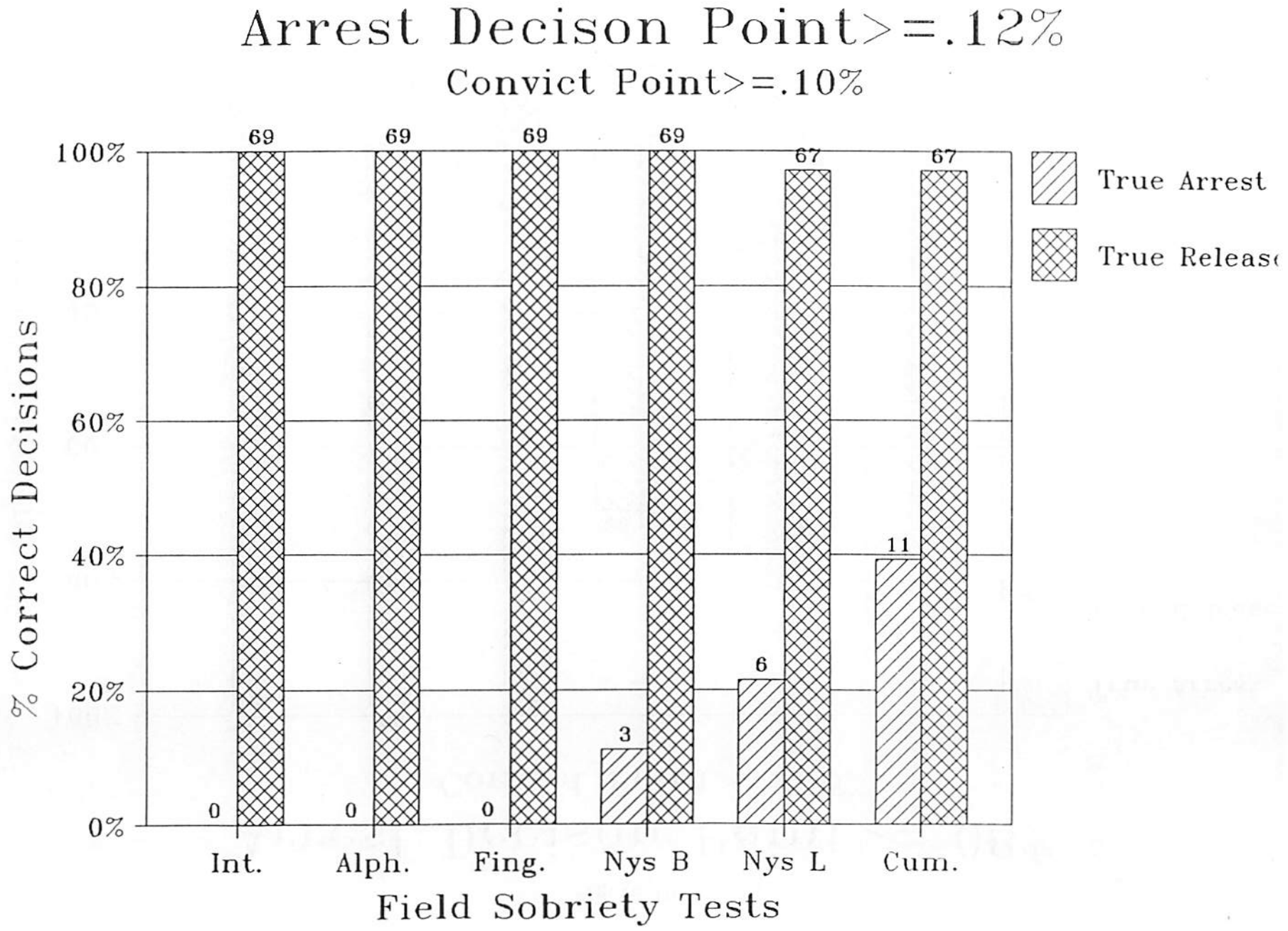
True Arrest
True Release
Int.
Alph.
Fing.
Nys B
Nys L
Cum.
Field Sobriety Tests

Figure 11


Arrest Decison Point>=.12%
Convict Point>=.10%
100%
80%
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% Correct Decisions
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Nys B
Nys L
Cum.
Field Sobriety Tests

a true release rate of 97%. Therefore, more of the guilty are being released but less of the innocent are being arrested. In addition, the arrest rate appears to be disproportionate low, since in this study very few subjects actually had BACs equal to or above 0.12%. Once the officers suspected this fact, they might have concentrated their estimates closer to a maximum of 0.10% BAC

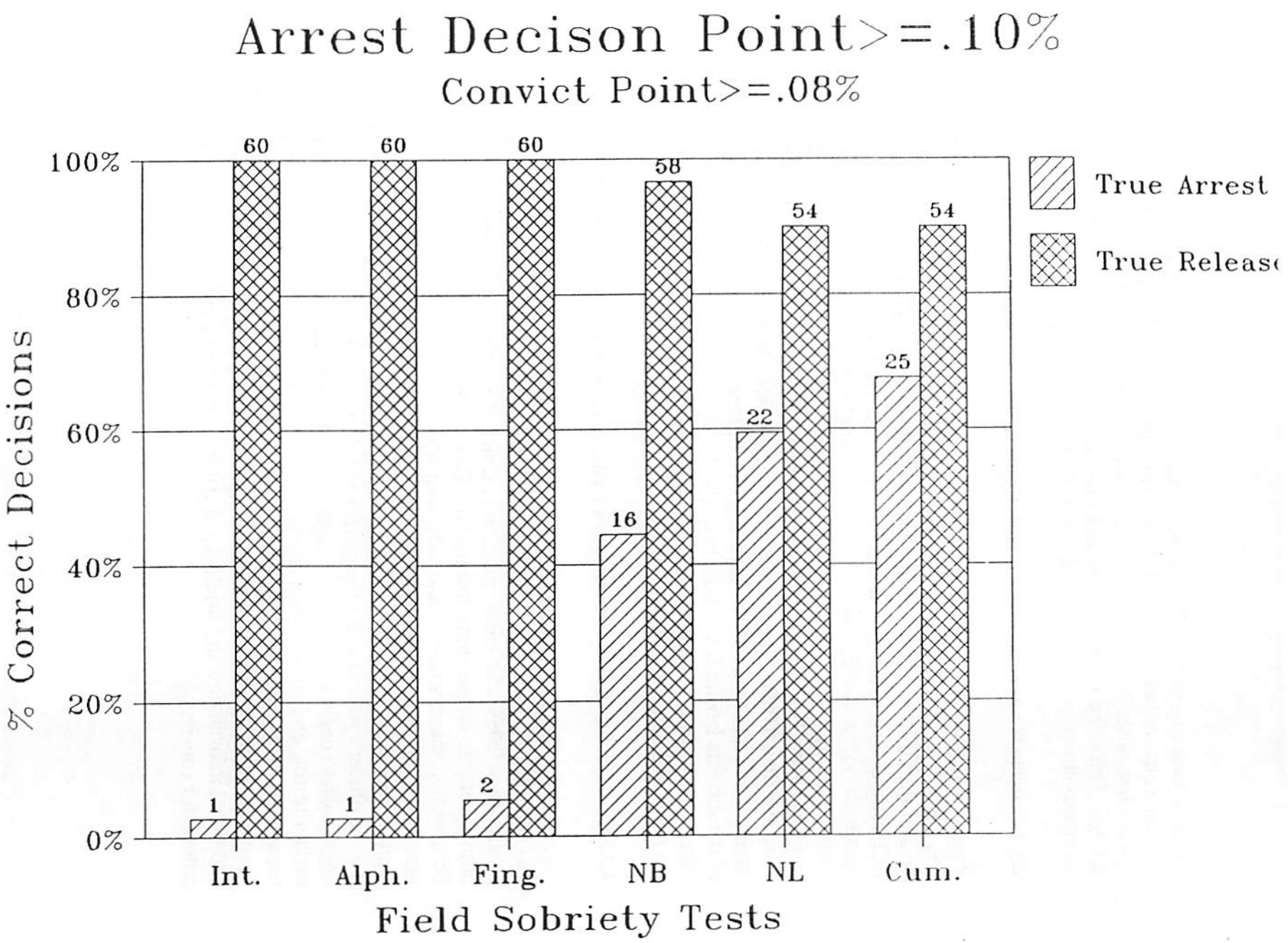
4.3.4 Criteria for Arrest at > =0.10% Criteria for Conviction at > =0.08%

Figure 12 depicts the decision indices for the scenario in which the conviction criteria was equal to or greater than 0.08% and the officers' criteria for arrest was equal to or greater than 0.10%. Table 4d lists the overall arrest/release decisions based on the six FST estimates of BAC. By the last BAC estimate (following administering the entire tests battery) the officers would have arrested 68% of the subjects having BACs equal to or greater than 0.08%. Inversely, the officers would have falsely released 32% of the subjects having BACs equal to or greater than 0.08%, i.e., estimating that their BACs were less than 0.08%. The officers would have correctly released 90% of the subjects having BACs less than 0.08%. Inversely, the officers would have falsely arrested 10% of the subjects having BACs less than 0.08%. As in the previous scenario, at this set criteria the officers are taking a conservative position. When doing so, less true arrests are made and more true releases result.

4.3.5 Criteria for Arrest at > = 0.08% Criteria for Conviction at > =0.10%

Figure 13 depicts the decision indices for the scenario in which the conviction criteria was equal to or greater than 0.10% and the officers' criteria for arrest was equal to or greater than 0.08%. This is a situation in which the officers, in order to increase the number of true arrests, have lowered the BAC arrest criteria. Therefore, they would be arresting more suspects and releasing less suspects. However, they would be arresting some suspects who were actually below the conviction criteria, i.e., arresting innocent persons. This is not a strategy which an officer usually would adhere to, since it is the officer's goal to arrest the guilty and release the innocent. However, an officer might wish to begin the OUI investigation with the strategy of detaining a suspect for further testing and investigation rather than for arrest, when the officer has estimated the suspect's BAC to be slightly below the conviction criteria. Once further testing had been conducted, the officer would then make the arrest/release decision based on the additional information and would use a criteria for arrest which is consistent with the criteria for conviction.

Figure 12


Arrest Decison Point>=.10%
Convict Point>=.08%
% Correct Decisions
100%
80%
60%
40%
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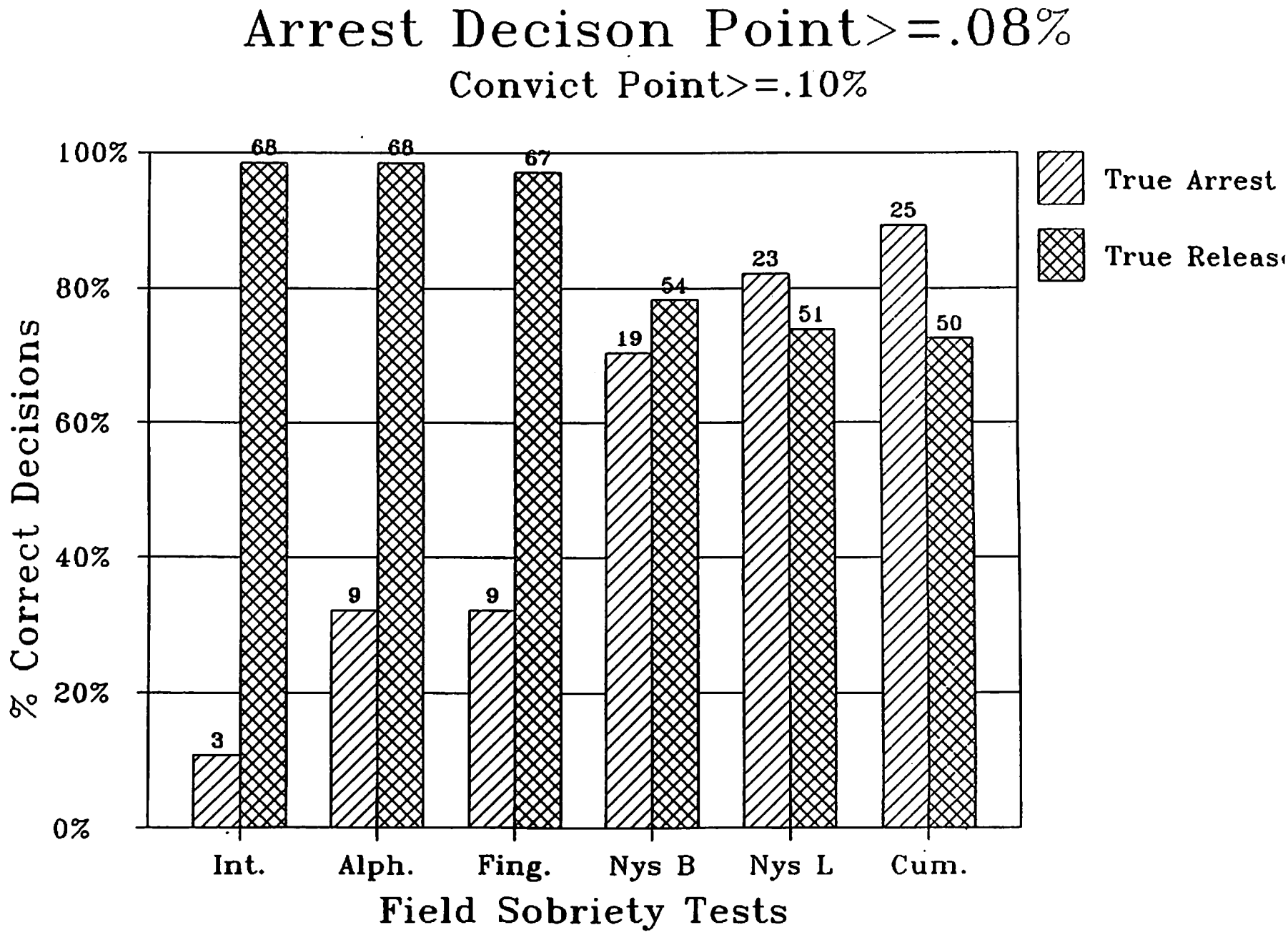
Field Sobriety Tests
True Arrest
True Releas

Figure 13


Arrest Decison Point>=.08%
Convict Point>=.10%
100%
80%
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20%
0%
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Nys B
Nys L
Cum.
Field Sobriety Tests
True Arrest
True Releas

Essentially, the officer is using a finer filtering or screening process as the investigation proceeds. The officer begins by detaining all suspects who are estimated to be at or above the conviction criteria 08%.. Table 4e lists the overall arrest/release decisions for all officers for each of the six estimates of BAC. By the last BAC estimate (following administering the entire test battery) the officers would have arrested 89% of the subjects having BACs equal to or greater than 0.10%. Inversely, the officers would have falsely released 11% of the subjects having BACs equal to or greater than 0.10%, i.e., estimating that their BACs were less than 0.10%. The officers would have correctly released 72% of the subjects having BACs less than 0.10%. Inversely, the officers would have falsely arrested 28% of the subjects having BACs less than 0.10%. Therefore, while more guilty suspects were arrested, more innocent suspects were also arrested.

4.4 Considering the Two Stage Test Process

The above examination of arrest/release decisions applies to the situation in which the officer has given the entire test battery. This would be analogous to the officer in the field asking all suspects (regardless of the officer's estimate of BAC) to return to shore in order to perform the on-land testing. However, in actual OUI detection, the officer would probably give the on boat tests to a suspect and reserve on land testing only for suspects who the officer estimated to have a BAC equal to or greater than the legal conviction criteria.

In the highway situation it is routine for the officer to administer on land balance tests. The officer simply asks the suspect to step out of the car but the highway officer does not have to transport the subject in order to perform the testing. The marine law enforcement officer must take the suspect to shore for further testing, a process which is quite time consuming. The officer needs to be fairly confident in his suspicions that the person is intoxicated before taking him/her to shore. It is, therefore, necessary that arrest/decision accuracy be examined for on-boat testing alone. The question is: How effective is the on-boat testing in aiding the officer to identify operators to be arrested for OUI?

As previously mentioned, Figure 9 and Table 4a refer to the decision indices for the scenario in which the conviction criteria was equal to or greater than 0.10% and the officers' criteria for arrest was equal to or greater than 0.10%. By the fourth BAC estimate (following the last on boat test, i.e., horizontal gaze nystagmus) the officers would have arrested 52% of the subjects having BACs of equal to or greater than 0.10%. Inversely, the officers would have falsely released 48% of the subjects having BACs of equal to or greater than 0.10%, i.e., estimating that their BACs were less than 0.10%. The officers would have correctly released 94% of the subjects having BACs less than

0.10%. Inversely, the officers would have falsely arrested 6% of the subjects having BACs less than 0.10%.

When these results are compared to the arrest/release decision indices which resulted from the officers administering the entire test battery, based on the results of on boat testing alone officers arrested a fewer number of suspects with BACs equal to or greater than 0.10%, i.e., 52% versus 75%.

Conversely using on boats testing officers falsely arrested a fewer number of suspects with BACs less than 0.10%, i.e., 6% versus 14%.

If on boat testing is used with a conservative arrest criteria, the results still appear to be worthwhile. This scenario would involve the officer being reluctant to bring a boater to shore for arrest unless he or she had great certainty that the suspect was legally intoxicated (the officer estimates the suspect's BAC is higher than the conviction criteria). For example, if the conviction criteria is 0.10% the officer might only bring suspects to shore for arrest with estimated BACs of 0.12% or greater.

Using the data from the current study, this would mean that after on boat testing the officer would have arrested 11% of the suspects having BACs greater than or equal to 0.10%. This would result in the officer detaining approximately one intoxicated suspect out of nine suspects having BACs greater than or equal to 0.10%.

Arresting only one guilty suspect out of nine may appear very inefficient. However, it should be considered that the limiting factor on how many suspects can be arrested and convicted is to a large extent the time required in the administrative procedures required to obtain a conviction. An OUI arrest often is a lengthy and costly process. On boat testing takes approximately fifteen minutes. If an arrest is to be made, the officer must make arrangements for securing the suspect's boat. Even in states which use breath or other chemical tests equipment may be located at distances which may require anywhere from fifteen minutes to an hour transport time. During all this time that officer is off the water and, therefore, not available for safety patrol. Finally in many jurisdictions the officer must devote considerable time to court procedures which limit the time he or she is available for patrol.

Using a conservative criterion the officer would be almost certain of a conviction. Considering the time required to make an arrest and the inconvenience to the boater who is falsely arrested, the use of the on boat tests with a conservative set point would increase the officer's confidence and make him or her vigorously proceed with the arrest procedure.

Analysis was performed in order to investigate possible strategies which can be used in testing in two stages. The arrest/release indices were calculated for various set criteria for on boat and on land testing. For example, instead of viewing the on boat testing criteria as arrest criteria, it can be considered as criteria for further investigation. Specifically, consider the scenario in which the officer decides that if as a result of on boat testing, he or she feels that the suspect's BAC is approximately 0.06% that suspect will be taken to shore for on land testing. Once on land the criteria for arrest will be 0.10%, the legal conviction level. In lowering the BAC criteria on the boat, the officer will be bringing more suspects to shore for on land testing than he or she would if only suspects estimated to be at 0.10% BAC were returned to shore for on land testing. This would be a strategy which result in a greater number of true arrests, but would also result in a lesser number of true releases. It would also result in a greater inconvenience for both the boater and the officer, i.e., time spent in testing. Table 8 lists a few such scenarios in which different criteria are set on the boat and on land.

Table 8
The Two Stage Decision Process

BAC Criteria			
On Boat	On Land	True Arrests	True Releases
0.10%	0.10%	48%	94%
0.08%	0.10%	59%	87%
0.06%	0.10%	70%	86%

The above table represents the decision process regarding 96 subjects. (One of the 97 subjects was omitted from the analysis, since on boat HGN was not performed for that subject due to technical difficulties with the boat on which he was a passenger.) This information is presented so that law enforcement officials may use these results as an aid in planning their arrest strategy. If their goal is to obtain the greatest number of arrests then lowering the criteria for further investigation is a reasonable approach. However, if their goal is to minimize the number of false arrests (maximize true releases), then maintaining an equal criteria for further investigation and criteria for arrest on land is a reasonable approach.

5 CONCLUSIONS

The objectives of this study were to determine if field sobriety tests were invalidated by the exposure of the individuals tested to the marine environment and to develop estimates of the effectiveness of a field sobriety test battery in aiding the marine law enforcement officer in identifying intoxicated boat operators. The data indicate that:

A. The accuracy of the field sobriety tests, when used on subjects exposed to recreational boating conditions, was as good as the accuracy of such tests when evaluated under simulated highway conditions.

B. The administration of the entire test battery improved the accuracy of the officers' estimates of BAC over estimates based on observation of and conversation with the suspect. As noted below, even the on-board Horizontal Gaze Nystagmus test resulted in a substantial improvement in accuracy over observation and conversation.

C. The Horizontal Gaze Nystagmus procedure appeared to provide the raters with the most accurate information of any single test. The major improvement in accuracy (of the combined estimates of all raters) occurred after the fourth BAC estimate which was based on-boat testing using the Horizontal Gaze Nystagmus test).

D. No significant difference in the accuracy of the combined estimates of all raters was found as a result of on land testing subsequent to the on boat testing (though two of six individual raters demonstrated small but statistically significant improvements in the accuracy of their BAC estimates as a result of the addition of on land testing).

6 RECOMMENDATIONS

The following recommendations cover the use of Training, Chemical Testing, On-boat Field Sobriety Testing (FST), On-Land (FST), and the Two Stage testing process:

Training:

- It is recommended that marine law enforcement officers be thoroughly trained in the use of field sobriety tests and in the use of portable breath testing equipment , especially in the use of these tests on the water.

  - Officers using FSTs should undergo a training course and in states which have a certification process be certified for use of the HGN. Once the officers have been trained they must have the opportunity to practice use of the test in the field to keep this skill current.

  - Formal training in the use of portable breath testing equipment is also necessary. Such training is required not only to ensure accurate testing but also to ensure that the officer adheres to procedures that result in obtaining admissible evidence.

Chemical Testing

- In states where permitted, portable breath testing units should be used to make an preliminary arrest/release decision subject to confirmation by other chemical testing. PBTs provide a quick and reliable reading of BAC.

  - If chemical testing is to be used to establish evidence of legal intoxication, time is critical. The suspect's BAC level decreases as alcohol is eliminated from the suspect's system. It is imperative that once the officer is confident that the person is intoxicated (based on the on boat testing), that the officer makes every effort to have the suspect agree to a chemical test of intoxication and ensure that the test is performed as soon as possible.

Field Sobriety Testing

- In those jurisdictions where chemical or breath testing to determine BAC is not possible, on-boat field sobriety testing provides critical aid to the officer in making arrest-release decisions. Even in cases where chemical tests are used to support boating intoxication convictions, field sobriety testing can substantially help the officer in making arrest/release decisions.

On-Boat FST

- The on-boat FST procedure should include the use of HGN. As noted above this provides the officer with the most accurate information of any on-boat procedure.

- It is recommended that marine law enforcement officers using FST procedures, where possible, use the methods of interview, and observation, as well as HGN testing. Each method can provide additional information on the suspect's level of intoxication.

- The observation portion of the FST should include the use of a checklist similar to that used in this study to refresh the officer's memory regarding points of observation. Through a structured interrogation the officer gains important information on any impairment of the suspect's speech and logic.

- If the officer suspects that the person is legally intoxicated the officer can proceed to performance tests, such as the alphabet recital, hand pat, finger-to-nose, and finger count as used in this study. Other similar performance tests may also be of value. The most essential element in performance testing is that they provide a structured situation in which the officer can observe a defined behavior.

- It is recommended that where on-boat testing is possible the HGN be given subsequent to the performance tests. Although as noted above the HGN appeared to be the most useful procedure, because this study assessed the effectiveness of an entire test battery it can not be proven that the administration of the HGN alone would result in the same accuracy as the administration of all the on boat tests.

  - As a practical matter it would be highly unusual for an officer to approach a suspect and immediately administer the HGN. Interview and observation is always the first step in a criminal investigation. The use of performance testing provides time for the officer to further observe the suspect's abilities and possible impairment.

On-Land FST

- Unless "Two-Stage Testing (see below) is to be employed it does not appear necessary for the officer to administer the HGN a second time, i.e., on-land. This study did not find significant differences between the scores obtained with the on-boat HGN and the on land HGN.

  - On land testing is time consuming (ten to fifteen minutes) and can be left to the discretion of the officer, if permissible under departmental procedures. The officer may wish to give the HGN on land in order to confirm the score obtained on the boat.

  - Although the use of the One-Leg Stand and Walk and Turn did not result in a significant improvement in the accuracy of the combined BAC estimate of all officers, two of the six officers did show small but significant improvements in accuracy. These tests may provide additional information to some officers.

Two Stage testing

- In addition to using on land testing in order to confirm the results of on boat testing and to further substantiate the arrest-release decision, on land testing can be used be used to supplement on-boat testing through the two stage decision strategy mentioned in the section 4.0.

  - By using different BAC criteria to identify suspects for further investigation (during on-boat testing) and criteria for arrest (during on-land testing), the officer can increase or decrease the true arrest rate. But it is important to remember that as the true arrest rate increases, the false arrest rate also increases.

  - Where possible a two stage procedure is recommended, for example: If after testing on the boat the officer is reasonably convinced that the suspect's BAC level exceeded the legal BAC conviction criteria of the state (in a state which has a per se law) and/or the tests indicate impairment which may pose a danger (in states with no per se law) the officer would bring the subject to shore and use the on-land testing for confirmation.

APPENDIX A

INDEX TO APPENDIX ITEMS

SCORING SHEET

Subject #: _____ Officer: _____
Date: _____ Time: _____

INTERVIEW:

Officer introduces self to subject. Asks subject for some identification and asks subject's name, address, and phone number, while subject is looking for ID.

Officer asks:	Response:
Without looking at your watch, what time is it?	_____
What is today's date?	_____
What day of the week is it?	_____
When did you last eat?	_____
What did you eat?	_____
Where did you eat?	_____
When did you last sleep?	_____
How long did you sleep?	_____
Are you ill or injured?	_____

OBSERVATIONS

CLOTHES	
	Condition: ☐ DISORDERLY ☐ DISARRANGED ☐ SOILED ☐ MUSSED ☐ ORDERLY (Describe) _____
BREATH	Odor of Alcoholic Beverage: ☐ STRONG ☐ MODERATE ☐ FAINT ☐ NONE
ATTITUDE	☐ EXCITED ☐ HILARIOUS ☐ TALKATIVE ☐ CAREFREE ☐ SLEEPY ☐ PROFANITY ☐ COMBATIVE ☐ INDIFFERENT ☐ INSULTING ☐ COCKY ☐ COOPERATIVE ☐ POLITE
COLOR OF FACE	☐ PALE ☐ FLUSHED ☐ NORMAL ☐ OTHER _____
EYES	☐ BLOODSHOT ☐ WATERY ☐ NORMAL
PUPILS	☐ NOT EQUAL SIZE ☐ CONTRACTED ☐ DILATED ☐ NORMAL
UNUSUAL ACTIONS	☐ HICCOUGHING ☐ BELCHING ☐ VOMITING ☐ FIGHTING ☐ CRYING ☐ LAUGHING ☐ NONE
SPEECH	☐ NOT UNDERSTANDABLE ☐ MUMBLED ☐ SLURRED ☐ MUSH MOUTHED ☐ CONFUSED ☐ THICK TONGUED ☐ STUTTERED ☐ ACCENT ☐ FAIR ☐ GOOD

INDICATE OTHER UNUSUAL ACTIONS OR STATEMENTS, INCLUDING WHEN FIRST OBSERVED: _____

BAC ESTIMATE: _____

Subject #: _____

1. ALPHABET RECITAL

INSTRUCTIONS:

Please recite the alphabet A through Z.

SCORING:

Satisfactory	_____
Recited slowly	_____
Thick and slurred speech	_____
Omitted letters	_____
Unable to perform	_____

2. HAND PAT

INSTRUCTIONS:

Watch what I do so you will be able to do the same thing. Don't begin until I tell you. (officer demonstrates.) Hold both palms out, facing up. Keep the left hand stationary and clap your palms together and count ONE. Turn your right hand over and clap the back side of your palm and count TWO. Keep counting (still demonstrating) ONE, TWO until I tell you to stop. As you count I want you to increase your speed.

Do you understand? Ready? Begin.

Have the subject count ONE, TWO about 10 times.

SCORING:

Satisfactory	_____
Failed to alternate palm and back of hand	_____
Hit side of hand	_____
Slow	_____
Unable to perform	_____

BAC ESTIMATE: _____

Subject #: _____

3. FINGER TO NOSE

INSTRUCTIONS:

Subject is seated. Hands at his sides.

Watch what I do so you will be able to do the same thing. Don't begin until I tell you. (Officer demonstrates.) I want you to close your eyes, put your arms down to your sides, tilt your head back slightly and when I say RIGHT, bring the tip of your right index finger to the tip of your nose. Then return your arm down to your side. When I say LEFT, bring the tip of your left index finger to the tip of your nose. Then return your arm to the side.

Do you understand? Ready?

Interrupt if there is significant deviation from the instructions. Repeat demonstration. Give second trial or discontinue.

Have subject perform RIGHT and LEFT for 2 or more trials.

SCORING:

Sure, accurate	_____
Slow but accurate	_____
Uncertain, fumbled but touched	_____
Required repeated instructions/ demostrations	_____
Did not return arm to starting position	_____
Touched with second and third finger joint, or with other finger, or with entire hand	_____
Missed completely	_____

Subject #: _____

4. FINGER COUNT

INSTRUCTIONS:

Watch what I do so you will be able to do the same thing. Don't begin until I tell you. I am going to touch my thumb and finger and count like this. (Demonstrate slowly and with slight exaggeration.) 1-2-3-4-4-3-2-1. Each time you do this, do it a little faster than the time before.

Do you understand? Ready? Begin.

Have subject count 1-2-3-4-4-3-2-1 three times.

Interrupt if there is significant deviation from the instructions. Repeat demonstration. Give second trial or discontinue.

SCORING:

Sure, accurate	_____
Confused, started over	_____
Counting error	_____
Did not correctly touch thumb to finger	_____
Required repeated instructions	_____
Unable to perform	_____

BAC ESTIMATE: _____

Subject #: _____

5. HORIZONTAL GAZE NYSTAGMUS

INSTRUCTIONS:

I am going to check your eyes. (If subject wears glasses ask him to remove them.) Please look at the tip of the pencil. Now, keep your head still and follow the tip of the pencil with your eyes. Only move your eyes, not your head. Do you understand? Watch the tip of the pencil.

(If the subject keeps moving his head, have him cup his chin with his hands.)

SCORING:

	Right Eye	Left Eye
1. Onset occurs before 45 degrees	_____	_____
2. Moderate/distinct nystagmus at extremes	_____	_____
3. Cannot smoothly follow a moving object	_____	_____
Total Score:		_____

BAC ESTIMATE: _____

Subject #: _____

ON-LAND TESTING

6. HORIZONTAL GAZE NYSTAGMUS

INSTRUCTIONS:

I am going to check your eyes. (If subject wears glasses ask him to remove them.) Please look at the tip of the pencil. Now, keep your head still and follow the tip of the pencil with your eyes. Only move your eyes, not your head. Do you understand? Watch the tip of the pencil.

(If the subject keeps moving his head, have him cup his chin with his hands.)

SCORING:

	Right Eye	Left Eye
1. Onset occurs before 45 degrees	_____	_____
2. Moderate/distinct nystagmus at extremes	_____	_____
3. Cannot smoothly follow a moving object	_____	_____
Total Score:		_____

BAC ESTIMATE: _____

Subject #: _____

7. ONE-LEG STAND

INSTRUCTIONS:

I am going to test your balance. Please stand with your heels together and your arms down at your sides, like this. (Demonstrate position.)

When I tell you to begin, I want you to raise one leg so that your heel is about six inches off the ground, and hold that position. Watch the toe of your raised foot and at the same time count from 1001 to 1030...like this.(Assume the position and demonstrate how you want the subject to stand and count.)

Do you understand? (Do not continue until the subject indicates that he understands.) Begin by raising either your left or your right foot and counting.

SCORING:

1. Sways while balancing on one leg. _____
2. Moves arms more than six inches to maintain balance. _____
3. Hops on one leg to maintain balance. _____
4. Puts foot down one or two times during thirty-second count.(Count this item only once.) _____
5. Cannot do the test. (Puts foot down three or more times, or loses balance. Score this item five points. _____

Total Score _____

Subject #: _____

8. WALK AND TURN

INSTRUCTIONS:

I am going to give you a test to check your balance. Please put your left foot on the line and then your right foot in front of it with your right heel touching your left toe. (Demonstrate the position.)

When I tell you to begin, take NINE heel-to-toe steps down the line, turn around, and take NINE heel-to-toe steps back. In turning around, make your turn by pivoting on one foot. Keep it on the line and use your other foot to turn yourself around with several small steps, like this. (Demonstrate) Keep your hands at your sides at all times, watch your feet at all times, and count your steps out loud. Do you understand? (Demonstrate again if subject does not understand.) Begin, and count your heel-to-toe steps out loud.

SCORING:

1. Loses balance during the instructions.	_____
2. Starts before the instructions are finished.	_____
3. Stops or pauses for several seconds while walking.	_____
4. Doesn't touch heel-to-toe. (Leaves more than 1/2 inch.)	_____
5. Steps off the line one or two times. (Count this item only once.)	_____
6. Raises one or both arms more than six inches to maintain balance.	_____
7. Doesn't turn correctly or loses balance during turn.	_____
8. Takes more or less than nine steps in each direction.	_____
9. Cannot do test. (Steps off the line three or more times, is in danger of falling, or otherwise demonstrates inability to complete the test. Score this item nine points.)	_____
Total Score:	_____

BAC ESTIMATE: _____

AGE DISTRIBUTION OF BOATING SAFETY PARTICIPANTS

Age	No
21	20
22	7
23	6
24	7
25	9
26	7
27	3
28	2
29	8
30	6
31	8
32	-
33	5
34	-
35	-
36	1
37	2
38	3
39	2
40	-
41	-
42	1
Total	97

BOATING AND ALCOHOL STUDY: Volunteers are needed to participate in a strictly controlled study concerning the effects of alcohol on boaters. The study will be conducted by a private research group utilizing RTC facilities from 11-22 May 1987. Criteria for volunteers: Male, 21-50 years of age, be in good health. Volunteers will be asked to: Drink measured amounts of alcohol, take a one-hour boat ride, take breath tests, participate in several field sobriety tests. The study will be conducted between the hours of 0700 and 1200. (Times for volunteers to report in). Each volunteer will be required to participate for one 8-hour period during the 10-day study. All sessions will be medically supervised. After testing, participants will be given food and rest prior to being driven home. If interested, contact MLE School, X2184.

TELEPHONE SCREENING INSTRUMENT

DATE:

NAME: MALE _____

ADDRESS: WEIGHT: _____

HEIGHT: _____

TELEPHONE NUMBER: DAY: NIGHT:

1. AGE:

   If less than 21 or greater than 50, tell them they do not qualify.

2. Are you presently taking any prescription or over-the-counter medication or drugs?

   If yes, what? _____

3. Do you go out on a boat?

   Often _____ Rarely _____ Never _____

4. Are you prone to seasickness?

   Yes _____ No _____

5. Do you ever drink alcoholic beverages?

   Yes _____ No _____

6. Have you ever been advised by a physician to abstain from or reduce the amount of drinking?

   Yes _____ No_____

   If Yes, Why?

7. How often do you consume alcohol?

daily	_____
several/week	_____
once/week	_____
several/month	_____
once/month or less	_____
never	_____

8. When you drink, do you usually drink

1-2 drinks	_____
3-4 drinks	_____
5-6 drinks	_____
Over 6	_____

Explain to the caller that an initial screening will be necessary. It will involve filling out a questionnaire that will take 15-20 minutes. This must take place before the actual experiment.

Availability to Participate in Study

THANKS A LOT FOR YOUR INTEREST, AND WE'LL GET BACK TO YOU SOON.

Name:

Telephone No.: Day _____

Evening _____

ALCOHOL QUESTIONNAIRE

FIRST PART

1. On a typical occasion when you are drinking distilled spirits (that is, whiskey, gin, vodka or beverages of that sort), how much of that type of beverage to you usually consume?
(Interviewer: Check one response; if a range of quantity is cited, check the lower figure.)

doesn't drink distilled spirits	0
one shot	1
two-three shots	2
four-five shots	4
six-seven shots	6
eight-ten shots	8
one pint	10
one pint to one fifth	15
more than one fifth	20

2. On a typical occasion when you are drinking beer, ale, or malt liquor, how much of that type of beverage do you usually consume?
(Interviewer: Check one response; if a range of quantity is cited, check the lower figure.)

doesn't drink beer	0
one 12-ounce bottle	1
two-three bottles	2
four-five bottles	4
one-two six-packs	10
more than two six-packs	15

3. On a typical occasion when you are drinking wine, how much wine will you usually consume?
(Interviewer: Check one response; if a range of quantity is cited, check the lower figure.)

doesn't drink wine	0
one glass (3-4 ounces)	1
two-three glasses	2
four-five glasses	4
one bottle	10
more than one bottle	15

4. How often do you drink during the morning?

daily	30
several/week	25
once/week	15
several/month	10
once/month or less	5
never	0

5. How often do you drink at lunchtime?

daily	8
several/week	5
once/week	3
several/month	2
once/month or less	1
never	0

6. How often do you drink during the afternoon, that is, after lunch is over but before the cocktail hour begins?

daily	15
several/week	10
once/week	7
several/month	3
once/month or less	1
never	0

7. How often do you drink at dinnertime, that is, either just before dinner or during the meal itself?

daily	5
several/week	4
once/week	3
several/month	2
once/month or less	1
never	0

8. How often to you drink during the evening, that is, after dinner is over?

daily	5
several/week	4
once/week	3
several/month	2
once/month or less	1
never	0

9. Speaking once again about your own typical drinking occasions, would you say that you most often drink in a private home, a bar, a restaurant, or some other place?

private home	_____1
bar/restaurant	_____2
other (specify)	_____

10. Once again in relation to your own typical drinking occasions, would you say that you most often drink with members of your family, with friends, with barroom clientele, or alone?

family	_____1
friends	_____2
barroom clientele	_____4
alone	_____8

11. At this point, I want you to think about the drinking you have done during the past 12 months. In particular, on how many occasions during the past 12 months have you vomited as a result of drinking?

never	_____0
once	_____2
twice	_____5
several or more	_____8

TOTAL SCORE: Questions 1-11: _____

SECOND PART

12. Have you ever been told that you have alcohol-related kidney disorders, liver trouble, or cirrhosis? Yes___(1) No___(0)

13. Have you ever had Delirium Tremers, severe shaking, or hallucinations? Yes___(5) (No___(0)

14. Have you ever awakened the morning after drinking and found you could not recall a part of the evening? Yes___(1) No___(0)

15a. Have you ever attended a meeting of Alcoholics Anonymous (AA) because of your own drinking? Yes___(1) No___(0)

15b. If No, has anyone ever seriously recommended that you attend such meetings? Yes___(1) No___(0)

16. Have you ever seen a clergyman, social worker, doctor, etc., for help with a problem related to your drinking? Yes___(1) No___(0)

17. Have you ever been in a hospital because of your drinking? Yes___(1) No___(0)

18. Have you ever been arrested for "drunk and disorderly" or "public intoxication?" Yes___(1) No___(0) If Yes, how many times? ___(x2)

19. Have you ever been arrested for "drunk driving," "driving while intoxicated," or "driving while under the influence of alcoholic beverages?" Yes___(1) No___(0) If Yes, how many times? ___(x2)

TOTAL SCORE: QUESTIONS 12-19:_____

THIRD PART

20. Do you have any problems with your balance?

Yes _____ No _____

If yes, describe:

SCORE

Group A	18+ on Part 1 1+ on Part 2
	or
	25+ on Part 1 0 on Part 2
Group B	18 - 24 Part 1 0 Part 2
Group C	Below 18 on Part 1 0+ on Part 2

ASSIGNMENTS

1/3 from Group A
1/3 from Group B
1/3 from Group C

Group A can be assigned to Groups B & C

Group B can be assigned to Groups A & C

Group C can only be assigned to Group C

Years of Experience in Marine Law Enforcement
and OUI Arrest Experience of Officers

Team One Officer #	Law Enforcement Agency/ Dept. of Natural Resources	Yrs. of Experience	Arrests*
1	Ohio	9	35
2	Maryland	14	100
3	Ohio	9	0
Team Two Officer #			
1	Ohio	15	6
2	Ohio	4	20
3	Maryland	15	12

* Arrest - refers to arrests occurring during three boating seasons, approximately late May to early Sept. 1986, 1985, and 1984.

DOSING TASKS

0700	Obtain Dosing Schedule for day 3 subjects
0700-0715	Obtain S1&S2 weight and BT1 results
0715	Mix DK1 for S1&S2
0720	Serve DK1 to S1&S2
0800	Obtain S1&S2 BT2 results
0800	Mix DK2 for S1&S2
0805	Serve DK2 to S1&S2
0800-0815	Obtain S3&S4 weight and BT1 results
0815	Mix DK1 for S3&S4
0820	Serve DK1 to S3&S4
0845	Obtain S1&S2 BT3 results
0845	Mix DK3 for S1&S2
0850	Serve DK3 to S1&S2
0900	Obtain S3&S4 BT2 results
0900	Mix DK2 for S3&S4
0905	Serve DK2 to S3&S4
0900-0915	Obtain S5&S6 weight and BT1 results
0915	Mix DK1 for S5&S6
0920	Serve DK1 to S5&S6
0930	Obtain S1&S2 BT4 results
0930	Mix DK4 for S1&S2
0935	Serve DK4 to S1&S2 for transport to boat...
0945	Obtain S3&S4 BT3 results
0945	Mix DK3 for S3&S4
0950	Serve DK3 to S3&S4
1000	Obtain S5&S6 BT2 results

1000	Mix DK2 for S5&S6
1005	Serve DK2 to S5&S6
1000-1015	Obtain S7&S8 weight and BT1 results
1015	Mix DK1 for S7&S8
1020	Serve DK1 to S7&S8
1030	Obtain S3&S4 BT4 results
1030	Mix DK4 for S3&S4
1035	Serve DK4 to S3&S4 for transport to boat...
1045	Obtain S5&S6 BT3 results
1045	Mix DK3 for S5&S6
1050	Serve DK3 to S5&S6
1100	Obtain S7&S8 BT2 results
1100	Mix DK2 for S7&S8
1105	Serve DK2 to S7&S8
1100-1115	Obtain S9&S10 weight and BT1 results
1115	Mix DK1 for S9&S10
1120	Serve DK1 to S9&S10
1130	Obtain S5&S6 BT4 results
1130	Mix DK4 for S5&S6
1135	Serve DK4 to S5&S6 for transport to boat...
1145	Obtain S7&S8 BT3 results
1145	Mix DK3 for S7&S8
1150	Serve DK3 to S7&S8
1200	Obtain S9&S10 BT2 results
1200	Mix DK2 for S9&S10
1205	Serve DK2 to S9&S10
1200-1215	Obtain S11&S12 weight and BT1 results

1215	Mix DK1 for S11&S12
1220	Serve DK1 to S11&S12
1230	Obtain S7&S8 BT4 results
1230	Mix DK4 for S7&S8
1235	Serve DK4 to S7&S8 for transport to boat...
1245	Obtain S9&S10 BT3 results
1245	Mix DK3 for S9&S10
1250	Serve DK3 to S9&S10
1300	Obtain S11&S12 BT2 results
1300	Mix DK2 for S11&S12
1305	Serve DK2 to S11&S12
1330	Obtain S9&S10 BT4 results
1330	Mix DK4 for S9&S10
1335	Serve DK4 to S9&S10 for transport to boat...
1345	Obtain S11&S12 BT3 results
1345	Mix DK3 for S11&S12
1350	Serve DK3 to S11&S12
1430	Obtain S11&S12 BT4 results
1430	Mix DK4 for S11&S12
1435	Serve DK4 to S11&s12 for transport to boat...

Note: Obtain BT5 Results for each pair hourly starting at noon to have feedback on dosing accuracy.

NOMINAL DOSING LEVELS

WEIGHT	GROUP B (BAC Target .06)		GROUP A (BAC Target .12)	
	Milliliters Per Drink	Total	Milliliters Per Drink	Total
120-130	18	72	25	100
131-140	19	76	27	108
141-150	20	80	29	116
151-160	22	88	31	124
161-170	23	92	33	132
171-180	24	96	35	140
181-190	26	104	37	148
191-200	27	108	39	156
201-210	28	112	41	164
211-220	30	120	43	172
221-230	31	124	45	180
231-240	32	128	47	188
241-250	34	136	48	192

ACTUAL DOSING LEVELS

SUBJECT NUMBER	GROUP	WEIGHT	TOTAL DOSE (MILLILITERS)
Monday 5/11/87			
7-1	A	No Show	---
8-1	B	205	104
9-1	A	166	124
10-1	B	204	106
11-1	C	186	16
12-1	C	208	16
Tuesday 5/12/87			
1-2	A	174	132
2-2	A	175	132
3-2	B	186	94
4-2	A	199	148
5-2	C	172	16
6-2	B	199	96
7-2	A	197	148
8-2	B	157	76
9-2	C	Withdrawn for Emergency Leave	
10-2	C	252	16
11-2		No Show	---
12-2	C	149	16
Wednesday 5/13/87			
1-3	A	183	140
2-3	C	173	16
3-3	B	205	106
4-3	A	182	140
5-3	C	173	16
6-3	C	221	16
7-3	A	174	132
8-3	B	193	103
9-3	A	198	150
10-3	B	162	86
11-3	B	160	85
12-3	C	215	16
Thursday 5/14/87			
1-4	C	208	16
2-4	B	178	100
3-4	A	140	113
4-4	B	139	55
(Note: Subject 4-4 arrived late and received only drinks 3&4)			
5-4	A	192	156
6-4	A	207	160
7-4	A	211	169
8-4	C	158	16
9-4	B	195	108

	10-4	C 198	16
	11-4	B 196	139
	12-4	C 212	16
Friday 5/15/87			
	1-5	B 141	76
	2-5	C 198	16
	3-5	A 161	139
	4-5	A 177	150
	5-5	B 176	108
	6-5	B 176	105
	7-5	C 155	16
	8-5	No Show	---
	9-5	C 131	16
	10-5	C 210	16
	11-5	No Show	---
	12-5	A 137	116
Monday 5/18/87			
	1-6	B 208	112
	2-6	B 197	115
	3-6	B 188	104
	4-6	B 174	96
	5-6	A 233	188
	6-6	A 174	147
	7-6	A 202	164
	8-6	A 173	145
	9-6	C 152	16
	10-6	No Show	---
	11-6	C 193	16
	12-6	C 195	16
	13-6	C 162	16
	14-6	B 202	112
Tuesday 5/19/87			
	1-7	A 157	129
	2-7	A 208	158
	3-7	B 161	99
	4-7	A 227	180
	5-7	C 174	16
	6-7	B 152	93
	7-7	A 196	149
	8-7	No Show	---
	9-7	No Show	---
	10-7	No Show	---
	11-7	C 224	16
	12-7	B 212	125
Wednesday 5/20/87			
	1-8	A 146	123
	2-8	B 195	108
	3-8	C 164	16

4-8	A	180	140
5-8	C	205	16
6-8	A	144	123
7-8	A	202	164
8-8	B	212	120
9-8	A	188	148
10-8	B	189	104
11-8	B	184	111
12-8	No Show		---
13-8	B	201	112
14-8	C	167	16

Thursday 5/21/87

1-9	A	240	191
2-9	A	181	148
3-9	C	176	16
4-9	C	209	16
5-9	C	213	16
6-9	A	162	139
7-9	B	182	111
8-9	B	167	99
9-9	B	189	104
10-9	B	179	102
11-9	C	207	16
12-9	C	191	16
13-9	C	217	16

MEDICAL REPORT

Name: _____ Height: _____

Address: _____ Weight: _____

_____ Age: _____

Phone: _____

Pulse: _____ Blood Pressure: _____ Heart: _____

Temp: _____ Respiration: _____ Color: _____

Are you presently taking any prescription or over-the-counter medication or drugs? Yes _____ No _____

If yes, what? _____

Examination Date: _____

Subject is/is not qualified to participate in controlled drinking study.

Yes _____ No _____

Examininer: _____

BRIEFING

Introduction

I am _____

As you know, we are requesting volunteers to participate in a research project to evaluate standard methods for testing intoxication. Today I am going to ask you to fill out a brief questionnaire to help us with our planning. Someone will call you in the next day or two to confirm the time and date of your participation. We are planning to start the project on May 11 and run it for about two weeks so your session will be somewhere during that time.

I will now go through the procedure so that you will understand what will be expected of you.

At the agreed upon time, you will arrive at the site of the study, where you will be expected to spend approximately 7 hours. Soon after your arrival, an attending nurse will conduct a brief medical screening. The nurse will check your blood pressure, temperature and pulse and ask about any medication you might be taking. The nurse will remain in attendance throughout the study. You will then be asked to consume a glass of fruit juice with a measured amount of alcohol each 40 minutes until three glasses have been consumed. Before and after each drink you will be asked to provide a breath sample by blowing into an automatic alcohol testing device. Following the third drink and breath test, you will be asked to board a boat for a boat trip. During the trip you will be asked to consume a 4th drink followed by another breath test. Police officers will then board the boat and administer standard sobriety tests. At the end of this trip, the boat will be docked and boarded by police officers who will give you further standard sobriety tests. You will be escorted off the boat. You will be given a meal and then asked to provide breath samples for testing at regular intervals to monitor the elimination of alcohol from your body. When your alcohol content level is at acceptable and legal limits for sobriety you will be transported to your place of residence.

You will be asked to sign an Informed Consent Form, a copy of which has been given to you for review.

Are there any questions?

Now you can proceed with completing the questionnaire. Please be assured that your responses will be considered private and confidential information and will only be seen by myself or people from my company. When the project is over it will be destroyed. If you have any questions while you are doing this please come up to see me.

INFORMED CONSENT FORM

Gentlemen:

I have agreed to participate in a research project to evaluate standard methods for testing intoxication. My consent to participate in this experimental research project does not in any way imply or constitute employment with the Federal Government or Dunlap and Associates, Inc. (D&A).

I understand the following conditions:

At an agreed upon time, I will arrive at the site of the study, where I shall expect to spend approximately 8 hours. Soon after my arrival, an attending nurse will conduct a brief medical screening and will remain in attendance throughout the study. I will then be asked to consume a glass of fruit juice with a measured amount of alcohol each 40 minutes until three glasses have been consumed. Before and after each drink I will be asked to provide a breath sample by blowing into an automatic alcohol testing device. Following the third drink and breath test, I will be asked to board a boat for a boat trip. During the trip I will be asked to consume a 4th drink followed by another breath test. Police officers will then board the boat and administer standard sobriety tests. At the end of this trip, the boat will be docked and boarded by police officers who will give me further standard sobriety tests. I will be escorted off the boat. I will be given a meal and then asked to provide breath samples for testing at regular intervals to monitor the elimination of alcohol from my body. When my alcohol content level is at acceptable and legal limits for sobriety I will be transported to my place of residence.

There has been no coercion, element of fraud or deceit, undue moral suasion or other adverse pressure brought to bear in my volunteering for this study. I have done so of my own free will and I can request that my participation be terminated at any time if in my opinion I have reached the physical or mental state where continuation becomes undesirable.

I am over the age of 21 years and I have no known physical or medical infirmities nor am I presently using any medication or drugs which make my participation in this program dangerous to my well-being or to that of others. I also understand that any information I provide to the study personnel will be kept in total confidence and will only be used anonymously in statistical combination with information from other participants and that the Alcohol Questionnaire that I completed will be destroyed at the end of the study.

My relationship to the Federal Government and D&A is that of a volunteer participant in a research project and nothing contained herein shall be construed as creating any other relationship. I hereby release and hold harmless D&A, their respective agents, servants and employees from any and all claims arising from my participation in or the conduct of the management of the program herein contemplated.

_____ _____

Witness Signature

_____

Date

_____

Address

_____

Telephone No.

References

Burns, M. and Moskowitz, H. "Psychophysical Tests for DWI Arrest", (Contract No. DOT-HS-5-01242). Washington, D.C.: Department of Transportation, NHTSA, June 1977.

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