INDEX OF EXHIBITS

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EXHIBIT A

STATE OF MARYLAND v. CONSOLIDATED CASES: Charles David Brightful K-10-40259, Harvey Alexander Carr, K-10-40331, Ryan Thomas Mahon, K-09-39370, Valerie Ann Mullikin, K-09-39636, Ronald Dale Teeter, K-10-40300, Jennifer Adeline Flanagan, K-10-40167, Christopher James Moore, K-09-39569, Darrell Patrick Peyok, Jr., K-10-40686, Ryan Lucas Mullinex, K-10-40575, Bonnie Denise Brisco, K-10-40783, Perry Gilbert May, K-10-40717, Matthew Bridger Farley, K-11-41045, Jessica Leigh Clark, K-11-41336, Rosemary Lynn Button, K-11-41468, Richard John Holmes, K-11-41475, Jack Edward Manger, K-11-41490, Michael Wayne Busey, K-11-41506, Troy Adam Director, K-11-41595, Timothy Charles Robertson, K-11-41610, Daniel Paul Cannavo, K-11-41627, Jonathan Tyler Carroll, K-11-41323, Ryan Lee Anderson, K-12-42335, Amy Michelle Giaraffa, K-11-42127, Stephanie Anne Baumes, K-11-42203, Bonnie Denise Brisco, K-11-41519, Richard Clarence Poling, K-11-42185, Mark Gertz, K-11-42060, Defendants

CONSOLIDATED CASES: K-10-40259, K-10-40331, K-09-39370, K-09-39636, K-10-40300, K-10-40167, K-09-39569, K-10-40686, K-10-40575, K-10-40783, K-10-40717, K-11-41045, K-11-41336, K-11-41468, K-11-41475, K-11-41490, K-11-41506, K-11-41595, K-11-41610, K-11-41627, K-11-41323, K-12-42335, K-11-42127, K-11-42203, K-11-41519, K-11-42185, K-11-42060

CIRCUIT COURT OF MARYLAND, CARROLL COUNTY

2012 Md. Cir. Ct. LEXIS 1

March 5, 2012, Decided
March 5, 2012, Filed, Entered

NOTICE: CONSULT LOCAL RULES REGARDING CITATION AND PRECEDENTIAL VALUE OF UNPUBLISHED OPINIONS.

JUDGES: [*1] JUDGE MICHAEL M. GALLOWAY.

OPINION BY: MICHAEL M. GALLOWAY

OPINION

MEMORANDUM OPINION AND ORDER

This matter came before the Court September 20, 21, 22, 23, 27, 28, 29, 30, 2010 and February 14 and 15, 2011 on the issue of whether the drug recognition expert, protocol and drug recognition expert testimony are admissible in the State of Maryland for prosecutions of persons suspected of driving under the influence of drugs or controlled dangerous substances. After hearing testimony and the arguments of counsel the Court held the matter *sub curia*.

Following these hearings Defendants filed their Motion To Exclude The Drug Recognition Expert Protocol and Drug Recognition Expert Opinion.

I. Background

The Drug Recognition and Classification Program ("DEC Program") was developed in 1979 by two sergeants with the Los Angeles Police Department. In 1986 the National Highway Traffic Safety Administration ("NHTSA") published the NHTSA, DRUG EVALUATION AND CLASSIFICATION TRAINING PROGRAM, STUDENT MANUAL ("DEC Manual") and in 1987 developed a national standardized curriculum. In 1990 the International Association of Chiefs of Police ("IACP") became the national certifying agency for the drug recognition examiners.

As part [*2] of the DEC Program, police officers with no formal scientific training enroll in a 72-hour course designed to teach them about the characteristics and effects of seven different categories of drugs on all major systems in the human body.[1] These police officers are taught to administer a twelve-step drug evaluation and classification protocol to subjects suspected of impairment.[2] The test takes approximately 45 minutes to and hour. At the conclusion of the twelve-step analysis the officer must decide (a) whether the subject has been driving while under the influence of a drug or drugs and, of so, (b) what category or combination of categories of drugs is impairing the subject.

1 **7 Drug Categories**

1. Central Nervous System Depressants
2. Inhalants
3. Dissociative Anesthetics
4. Cannabis
5. Central Nervous System Stimulants
6. Hallucinogens
7. Narcotic Analgesics

2 **12 Steps of the Drug Evaluation Process**

1. Breath Alcohol Test - A sample of breath is taken from the test subject to determine the concentration of alcohol, if any, in the test subject.
2. Interview of Arresting Officer - The DRE consults with the investigator(s) to determine the circumstances leading up to the apprehension of the test [*3] subject.
3. Preliminary Examination - Initial examination of the subject Some questions are asked in relation to the subject's medical/physical limitations.
4. Eye Examination - Eyes are examined for pupils being equal, the ability of the eyes to track a stimulus equally, to monitor the smoothness of that tracking, to look for Horizontal Gaze Nystagmus, as well as Vertical Gaze Nystagmus.
5. Divided Attention Tests - One Leg Stand is done with both legs- Walk and Turn test is done. Modified Romberg Balance test And Finger to Nose test is done.
6. Examination of Vital Signs - Blood pressure, pulse and body temperature is taken.
7. Dark Room Examinations - Examination of the pupil sizes in near total darkness, under direct light, and in normal room light. Examination of the oral and nasal cavities are done at the same time.
8. Examination of Muscle Tone - Flexion and Extension of the muscles are tested, to see if there is flaccidity, or rigidity of the muscles.
9. Examination of Injection Sites - Examination of common injection sites to determine if the subject is using injected substances.
10. Suspects Statements / Other Observations - Soliciting information from the test subject which will [*4] corroborate signs and symptoms that the evaluator has observed,
11. Opinion of the Evaluator - The DRE makes a determination of the class or classes of drugs that a subject is under the influence based on a matrix of symptomology that has been developed during studies of subjects under the influence of known classes of drugs,
12. The Toxicological Examination - Blood, saliva or urine is obtained by demand, which is analyzed to determine what class of substances are present that corroborates the DRE's opinion.

To become a certified Drug Recognition Examiner ("DRE") a police officer must take a 72-hour course and obtain a score of at least 80% on the final exam.

Although the DRE program is utilized in 45 states, the presence of the DRE program does not equate to widespread judicial acceptance by appellate courts nor acceptance in the medical community.

II. Expert testimony

The State presented six expert witnesses: Dr. Karl Citek, Ms. Michelle Spirk, Mr. William Tower III, Officer William Morrison, Lt. Thomas Woodward and

Dr. Zenon Zuk.

Dr. Karl Citek testified that he is an optometrist who is also a primary care physician. He testified that he did not attend medical school. (Tr. 9/20/10 at [*5] 38) He testified that he is a member of the adjunct faculty at the Institute of Police Technology and Management and teaches a course called Medical Foundations of Visual System Testing, a three-day course on the medical and scientific background behind the DRE protocol. (Id. at 26) Dr. Citek testified that he has given presentations and lectures to DREs for which he has received some compensation and has observed DRE certification training in Oregon, Florida and Louisiana on at least 100 occasions. (Id. at 35, 48) Dr. Citek testified that the DRE courses are commonly taught by other police officers. (9/20/2010 at 179, 203) He testified that the DRE is "making a diagnosis of whether the person is impaired by a drug or medical condition." (Tr. 9/20/10 at 154). Dr. Citek testified that he is not a member of the IACP or the DRE technical advisory board. (Id. 183) Dr. Citek testified that there is no set number of major or" general indicators that a DRE needs to find to reach an opinion, of drug impairment, although in his opinion only one indicator would not be enough to find drug impairment. He further testified that DREs are not instructed by the DEC Program that only one indicator [*6] would be insufficient. (Tr. at 208, 219) Dr. Citek described the DRE protocol as "a diagnostic test" that allows [DREs] "to differentiate not only between impaired and unimpaired people but, when impairment is found, whether it is a medical or drug impairment." (Tr. 9/20/10 at 220) Dr. Citek testified that there are medical disorders that will actually cause smooth pursuit and distinct and sustained nystagmus at maximum deviation and when distinguishing between medical and drug impairment the DRE must understand how many clues are necessary to find HGN. (Tr. 9/21/10 at 25) Dr. Citek testified that these medical disorders are not explained in the DEC Manual and this is "another shortfall of this manual...and the training" and he has recommended in the past to make changes to the manual. (Id. at 25) Dr. Citek testified that there is "nothing in the medical or scientific community that validates that HGN makes you unable to drive safely." (Id. at 37)

Ms. Michelle Spirk testified that she has a Masters Degree in Bio-Chemistry and has been employed with the Arizona Department of Public Safety for twenty years. She testified that she supervises toxicologists who perform blood, alcohol, urine, [*7] and blood drug screening. (Tr. 9/21/10 at 79, 119) Ms. Spirk testified that she was been heavily involved in the DRE program since she began work in the Arizona State Crime Laboratory. She attended DRE school during her first year of employment. She testified that she sits on the Arizona DRE Steering Committee and attends "monthly meetings. (Id. at 82-83). She testified that she teaches for the Arizona DRE program. She testified that she does not have a degree in toxicology, forensic toxicology, or any area of pharmacology. (Id. 92-93) The State offered her as an expert in the areas of pharmacology, clinical research, forensic toxicology, and DRE protocol. The Court qualified Ms. Spirk to testify in the field of toxicology only. (Id. at 131) Ms. Spirk was allowed to testify "as to the possible effects of a drug, but hot the effect on driving." (Id. 145)

Mr. William Tower III testified that he is a law enforcement liaison for the National Highway Traffic Safety Administration and International Association of Chiefs of Police (IACP). In 1987 he and two other specialists developed the DRE curriculum. (Tr. 2/14/11 at 12-15)

Mr. Tower testified that the DRE was developed by police officers [*8] from the Los Angeles Police Department. In 1979 the Drug Recognition program received the official recognition of the LAPD. Mr. Tower testified that in 1986 the National Highway Traffic Safety Administration ("NHTSA") became involved in order to make a more standardized manual and a certification process for use nationally. (Tr. 2/14/11 at 16-17, 22) Mr. Tower testified that NHTSA took parts of two programs existing at the time, the LAPD and the California Highway Patrol, and by 1987 developed a national standardized curriculum. (Id. at 25-26, 42) In 1990 the International Association of Chiefs of Police ("IACP") assumed control of the DEC Program. (Id. at 53) Mr. Tower testified that the program is utilized in 45 states.

Mr. Tower testified that a police officer who enters the DEC Program to become a DRE is not required to have any prior medical training. (Tr. at 182) An officer must take a standardized three-day course on field sobriety tests followed by a two-day DRE test. If the officer passes with 80 or above, he will begin the seven-day DRE school where he will learn the 12-step process and must take a 100-question test at the end and pass with a score of at least 80, (Id. at 27-28)

Mr. [*9] Tower testified that the DEC Program seeks to train police officers to conduct a "systematic and standardized" examination of a suspect in order to determine:

> 1. Whether the subject is impaired; and, if so,
> 2. Whether the impairment is caused by drugs or a medical condition; and, if drugs,
> 3. The category or combination of categories of drugs that are the likely cause of the subject's impairment.
>
> (Id. at 30-32)

Mr. Tower further testified that in addition to the wide discretion in what weight to give the indicators on the matrix, the DRE is not even required to complete the 12-step protocol to reach an opinion as those steps are merely "preferred." (Tr. 2/14/11 at 95-96). **Mr. Tower testified that even if no drugs at all are found in the subject's blood, the DRE is "not going to change [their] opinion after you get the blood**." (Id. at 103-04) **Mr. Tower stated that the reason there would be no change in the officer's opinion is that "you are limited on what the lab can test for**." (Id. at 104) (Emphasis supplied.)

Officer William Morrison testified that he is a member of the Montgomery County Police Department. He is the coordinator for the Montgomery County Police Department's Chemical Test [*10] Unit. Officer Morrison testified that he maintains intoximeters and oversees blood testing and the County's. DRE program. He is also responsible for training related to underage drinking, DWI and preliminary breath testing. Officer Morrison has been a certified DRE since 1991. Officer Morrison testified that he teaches DRE in-service training and has performed over 1,000 DRE evaluations. (Tr. 2/14/11 at HO)

He testified that as soon as a DRE is certified they are considered fully qualified to render an opinion, including ruling out medical causes, for any perceived impairment by the officer. (Id. at 80-91) He testified that the DRE is specifically making a medical diagnosis during the examination by ruling out medical conditions during the examination. (Id. at 207)

He testified that when the matrix says "indicated" it means only that it indicates that several things could be present--it could indicate the presence of drugs, impairment by drugs, or could simply be impairment by a medical condition. (Tr. 2/15/11 at 25) Officer Morrison who testified that he has been involved with the program for 20 years and a long-time instructor testified that he had no idea why some indicators are called [*11] "Major" and others are called "General." (Id. at 25-26) Officer Morrison testified that he does not need to have any set number of indicators in order to find someone impaired because a DRE looks at the "totality of everything" and ultimately it comes down to their medical judgment. (Id. at 59, 65)

Lt. Thomas Woodward testified that he is the current commander of the Maryland State Police Barrack in Hagerstown, Maryland. He has served in law enforcement for thirty years and before his assignment in Hagerstown he was commander of the chemical test for alcohol unit. (Tr. 2/15/11 at 87) He testified that he has been State coordinator for the Maryland DRE program for the last ten years and is responsible for ensuring" Maryland". DREs are trained and certified according to IACP guidelines.
(Id. at 88)

Dr. Zenon Zuk testified that he has practiced medicine for 30 years and the majority of his practice involves workers' compensation cases. He has testified on behalf of the DRE protocol fifteen times. (Tr. 9/22/10 at 176) Dr. Zuk testified that he reviewed the DRE Manual before testifying today and prior to that he had not read the DRE Manual for fifteen years.

He testified that he performs work [*12] for the Western Branch of the United States Immigration Service and administered deportation protocol to be used during in-flight deportations. (Tr. 9/22/10 at 171-172) The purpose of the protocol was to insure that the Justice Department was not fined for emergency landings or aborted landings by medical mishaps in flight. (Id. 171-172) He testified that he sedated deportees with drugs to assure their cooperation and that one of the drugs he used was a PCP dissociative anesthetic call Droperidol. (Tr. 9/23/10 at 36) He testified that in 17 years he did a total of 182 sedations and that "in probably half the cases it would be considered against their will.'" (Id. at 36) He testified that "the effect on the individuals that I administered it so that it would--they would still perceive an awareness of an event that they were anxious about but they demonstrated less concern about it. So, it was -part of the reason why a dissociative anesthetic made so much sense--it really cuts off their ability to respond emotionally to what they know cognitively." (Id. 36)

He testified that he became interested in the DRE program because he wanted to learn the DRE skill set with its use of the Tharp's [*13] Equation. (Tr. 9/23/10 at 49) He testified that the Tharp's Equation is used by a DKE to quantify a suspect's blood: alcohol content and also determine if a suspect is impaired by a drug. He testified that the Tharp's Equation is "blood alcohol content equals 50 minus angle of onset." (Id. at 50)

He testified that during his medical training he never saw or was taught that one could predict the presence of other drugs inside a human being based on the discrepancy between an angle of onset of nystagmus and the breath alcohol level. (Tr. 9/23/10 at 49, 84)

Defendants' called three experts: Dr. Francis Gengo, Dr. Neal Adams, and Dr. Jeffrey Janofsky.

Dr. Francis Gengo testified that he is a clinical pharmacologist with a post doctoral fellowship in pharmacokinetics and pharmacodynamics. Dr. Gengo has held various academic appointments at SUNY Buffalo including Associate Professor of Pharmacy, Associate Professor of Neurology in the School of Medicine and a courtesy appointment in the Department of Neurosurgery where he lectures to neurosurgery residents about the use of medications in patients who have acute neurologic problems. He currently holds two positions at the Dent Neurologic Institute: [*14] Director of Clinical Research for the Dent Neurologic Group and Chief Science Officer for the Dent Neuroscience Research Center. Dr. Gengo teaches medical and pharmacology students as part of a clinical rotation from SUNY Buffalo. Dr. Gengo 'testified that he is responsible for medication therapy management and conducts comprehensive reviews of patient records to determine specific efficacy and toxicity of patient medications and eliminate redundant medications. (Tr. 9/28/10 13-20)

Dr. Gengo has authored sixty-five peer reviewed and published articles and three of those articles are specifically in the area of drug impaired driving. He has contributed to text books in the field of clinical pharmacology, e.g., Neurology In Clinical Practice, Clinical Pharmacokinetics, and Drug Effects On Human Function. (Id. at 26-27)

Dr. Gengo testified that the DRE makes largely subjective observations. Dr. Gengo stressed that "the DRE technician...is not in a position to appreciate other diseases much less diagnose their presence" and would have to exercise medical and pharmacologic judgment to do so. (Tr. 9/28/10 at 86) Dr. Gengo testified that he has not seen "any data to demonstrate that [DREs] [*15] can discern medical disease induced problems from drug induced impairment" and it is his opinion based on his training in pharmacology and clinical research that they cannot do this." (Id. at 87, 89) Dr. Gengo testified that the information collected by the DRE is simply not sufficient to render a medical diagnosis. (Id. at 90)

Dr. Gengo testified that while the DREs may be using well-established principles such as blood pressure, pulse, and eye examinations "those tools are being used by [DRE] technicians in a novel and unreliable way." (Tr. 9/29/10 at 90) He further testified that there is a difference between evaluating alcohol and drugs and the effect a specific drug has on an individual would have many more variables than one generally sees with alcohol. Dr. Gengo testified that a person suffering from withdrawal from methadone would be suffering from profuse sweating and would be distracted, agitated, irritable, and their blood pressure would be elevated. That person could appear to be under the influence of a drug when in fact there is not enough of the drug in their system. A DRE would have to distinguish somehow between signs and symptoms exhibited by someone who actually had [*16] no drug in their blood. (Tr. 9/28/10 at 62-63)

Dr. Gengo testified that the drugs referenced in the matrix are misclassified and that some Of the drugs have a completely different effect on the body than what is predicted in the matrix. (Tr. 9/28-/10 at 67) He testified that the classification system is far too broad and that even if the classification is limited to anti-depressants there are many different types that affect the central nervous system differently. (Tr. 9/28/10 at 64) He went on to say that "the data has spoken for itself that [the DRE protocol] cannot reliably discern impairment from non-impairment and cannot reliably identify the medication allegedly causing the impairment." (Id. at 91) Dr. Gengo testified that the matrix lists duration of effects for certain drugs and that the information contained is all but meaningless because of the grouping. (Tr. 9/28/10 at 145) He testified that the seven categories are so vague and they contain such a diverse group of drug classes that the duration of effects contain little or no useful information. (Tr. 9/28/10 at 146)

Dr. Neal Adams testified that he is an ophthalmologist and was trained at Johns Hopkins University's Wilmer [*17] Eye Institute. Following his residency, Dr. Adams received a medical "degree from Johns Hopkins University. He testified that he is licensed to practice ophthalmology in three states including Maryland. (Tr. 9/29/10 at 8-12) He testified that he was appointed Division Chief of Visual Physiology and Director of the Retinal Eye Institute at Wilmer Eye Institute while simultaneously holding the position of assistant professor of ophthalmology. He testified that he was designated a "Monumary Scholar," the school's highest teaching award. He received advanced training at the National Bye Institutes and thereafter held key clinical research positions utilizing National Institutes of Health grants. Dr. Adams accepted an appointment as Chair of the Ophthalmology Department at Texas Tech University Medical School. Dr. Adams has participated in multiple clinical trials involving the effect of pharmaceuticals on vision and other issues. (Id. at 18-20)

Dr. Adams testified that the "Tharp's Equation is a gross distortion of what is in the medical literature. Other than that, I don't find any validity in the field of medicine or in the field of ophthalmology to this equation." (Tr. 9/30/10 at 23-26) [*18] Dr. Adams testified that he doesn't "agree with the DRE protocol in the way it is being used." (Id. at 83) He noted that the matrix "doesn't tell us relative weights of what is more important and what to evaluate in one manner versus a different manner. We are looking at almost a robotic matrix..." (Id. at 36) Dr. Adams gave his reasons for criticizing the way the DRE is taught to use the matrix:

> Medical judgment, is using items that may be in a matrix and placing our own experience, our own understanding of the medical literature, placing the knowledge that we have gained into that matrix, understanding the relative weights of different items in that matrix and coming out with a judgment. So that even if we were using this matrix in its totality

> without anything else, there is an element of judgment that we as physicians would incorporate to assist us. And that is not present; that is, it is a very important component of the matrix that is not present in this matrix. And that is what I was trying to get at is how we as physicians interpret these.

(Id. at 37)

Dr. Adams testified that whether it is a doctor or "someone who has this specific expertise," the examiner must consider 11 questions [*19] before diagnosing nystagmus:

> 1) Is there nystagmus or instability present in the primary position of gaze? If so, is it voluntary or involuntary?
> 2) What is the wave form of a nystagmus, is it pendular or jerk?
> 3) What is the frequency of the nystagmus?
> 4) What is the direction and "trajectory of the quick phase of nystagmus?
> 5) What is the effect of a center gaze on Nystagmus? Is it gaze evoked?
> 6) Is a nystagmus conjugate or disconjugate? Is it disconjugate, is it disassociated meaning mainly or only in one eye? Or is it disjunctive? Equal and oppose in the two eyes?
> 7) Is the nystagmus induced or influenced by maneuver such as head tilting, changes in head posture, convergence, covering of one eye., removal of visual fixation... closing of both eyes or hyperventilations?
> 8) Is the nystagmus periodic?
> 9) Is the nystagmus associated with any ocular or gaze palsy?
> 10) Is the nystagmus associated with any other involuntary movements, for example, involuntary movements of the head, eyelids, pallet or ear drum?
> 11) Is the nystagmus symptomatic and, in particular, is it causing ocillopsia?

(Tr. 9/29/10 at 27-29)

Dr. Adams testified that in the Shinar Study (Defense Exhibit 4) DREs found HGN in categories [*20] where a drug could not even cause HGN and in his expert opinion that demonstrates "that you really need two things to interpret nystagmus. You need a properly performed test and you need to understand nystagmus and be able to ask these other eleven questions to be able to determine where that nystagmus came from." (Tr. 9/29/10 at 57-58) He further testified that none of the questions that must be asked in order to properly diagnose nystagmus, however, are asked by the DRE. (Id. at 61) He testified that there are many medical conditions that can cause HGN including the flu, measles, eye strain, glaucoma and heredity, as well as substances such as caffeine and aspirin and it is very difficult even for physicians to distinguish between medical conditions and alcohol or drugs. (Tr. at 62-64)

Dr. Jeffrey Janofsky testified that he is an associate professor of psychiatry at Johns Hopkins University School of Medicine. He is also an educator at The University of Maryland and the Maryland Judiciary as part of the ASTAR program. He testified that he teaches a clinical psychiatry program that involves' medical students, nursing students and social work students. The program administers health [*21] care to patients who are ill mentally and physically and are either currently using drugs or have used drugs in the past. (Tr. 9/23/10 183-186) Dr. Janofsky was appointed a Clinical Professor of Psychiatry at the University of Maryland. He is co-director for the Pretrial Mental Health Screening Program for the District Court. He supervises University of Maryland medical students, residents and fellows who are rotating' through forensic psychiatry, teaching them how to do various kinds of evaluations. He has authored twenty-four peer reviewed scientific journal articles that have appeared in the Journal of Academy of Psychiatry and the Law, The Journal of the American Academy of Psychiatry and the Law, as well as the Journal of the American. Psychiatric Association. (Id. at 171-174)

He testified that peer reviewed and published literature must be performed before a technique like the PRE would be accepted among the medical and scientific communities. He testified that when he was asked to review the DRE program in 1992 he found that "there was actually not a single' study regarding the DRE published in ... peer review scientific literature." **He testified that if they're going to perform [*22] a test that purportedly predicts an impairment by a specific drug, which he believes no reasonable clinical practitioner would ever do, you would want a couple of peer reviewed studies that say you can do it considering it's about criminal sanctions**." (Emphasis supplied.) (Tr. 9/23/10 at 200-01)

Dr. Janofsky testified that the PRE 12-step protocol and matrix is not a diagnostic test or a standardized protocol because it requires clinical medical judgment. (Tr. 9/23/10 at 216-18) Dr. Janofsky further testified:

> Folks that don't have such [medical] training, for example, laboratory technicians or aids can be trained to

> administer a protocol as long as it's done in exactly the same way every single time and the results can be clearly discerned from each stage.
>
> So you would never ask someone who is acting as a technician to use their judgment to decide which DRE factors on the matrix are most important or, even more ridiculously frankly, to rule out a medical condition. They can't do it. They don't have the training or experience to do it.
>
> So, when you design a protocol for a non-professional, it's very important that it be standardized in a way that can be done the same way over and over [*23] again that's reliable n', meaning that when multiple people test the same subject they get exactly the same result and that it's valid. That it repeatedly actually measures what it purports to measure.
>
> All of the studies that I've reviewed showed first of all there is no reliable data at all and showed that the studies are not valid when tested appropriately.

(Id.)

Dr. Janofsky testified that the matrix is not something accepted in scientific and medical communities. He replied when asked whether he knew anyone in the medical, psychiatric, scientific, or clinical research fields who accepted the matrix as useful:

> I have got to tell you, your Honor/ DRE is something that's not foremost in the mind of those of us who take care of substance abusers, clinically or forensically. People are aware of it. But it's - no one I know of, no physician I know of would even consider using this matrix or the - even pieces of it in determining either whether someone was impaired on drugs or even more ridiculously to tell which specific drug category. It's ridiculous--I can't emphasize that enough.

Id. at 223.

Dr. Janofsky testified that there is a major difference between alcohol and drug interactions in [*24] the body. He further testified that the DEC Manual improperly equates the medical definition of impairment with impairment to drive. He testified that the DEC Manual does not address the concept that certain indicators may only show the "presence of the drug and-not intoxicating levels causing behavioral impairment." (Tr. 9/27/10 at 96-97). Dr. Janofsky testified that while there are studies linking alcohol to driving impairment, no studies exist regarding the drugs the DRE lists in its seven categories. Dr. Janofsky also testified that the drugs identified in the seven drug categories are incorrectly lumped together, i.e., the CNS depressant class which includes barbiturates, Benadryl, various benzodiazepines and antidepressant medications that no physician would group together because they have extraordinarily different neurophysiologic actions. (Tr. 9/27/10 at 57.) He testified that there are whole classes of drugs listed under CNS depressants that would have the opposite effect on the body than what is listed for that drug category in the matrix. (Id. at 58) He testified that this misinformation contained in the DEC Manual leads to unreliable and incorrect DRE opinions and demonstrates [*25] how difficult it is for someone with no medical background to make such a medical diagnosis. (Id. at 58) He testified that some drugs the DEC Manual lists as a CNS Depressant do not cause nystagmus even though the matrix says they do which in his opinion is "a major problem." (Id. at 90-91) He testified that this type pf problem exists with all the types of drugs in the matrix. (Id. at 58-59) He further testified that there is no research to show that HGN impairs the ability of someone to drive and it is not used in the medical field as an indicator to show drug impairment. (Id. at 50-51)

Dr. Janofsky testified that vital signs axe not something the medical community uses to show drug impairment, and he knows of no one in the medical field that does use vital signs as an indicator. (Id. at 51)

Dr. Janofsky testified that in his opinion the entire "totality of the circumstances" approach the DRE uses in reaching ah opinion is "absolutely" a new and novel application that is not accepted in the medical community. (Id. at 70) Dr. Janofsky testified that "if the DRE is allowed to testify to a reasonable degree of a police officer's certainty that based on this matrix the person is intoxicated, [*26] the Court will be receiving inaccurate and false evidence and will be convicting the wrong people." (Id. at 86)

III. Discussion

The issue before the Court is whether the Drug Recognition Protocol and drug recognition expert testimony is admissible in the State of Maryland for prosecution of persons suspected of driving under the influence of drugs or controlled dangerous substances.

The State must prove by a preponderance of the evidence that the DRE program is admissible under *Frye-Reed* by offering testimony and exhibits and persuasive" authority from, other jurisdictions to show that the protocol is not new or novel and the relevant scientific community agrees that the DEC program's methodology produces accurate results as there is no Maryland appellate decision on this issue.

The defense alleges the protocol is new and novel and the science it is based on is not generally accepted within the scientific community.

The drug recognition protocol, whether analyzed under the *Frye-Reed* standard as a new or novel scientific technique or under *Md. R. 5-702* as expert witness testimony based on specialized knowledge, is inadmissible for the following reasons:

1. The *Frye-Reed* Standard

Frye v. United States, 293 F. 1013 (D.C. Cir. 1923) [*27] sets forth the admissibility standard governing expert testimony as to novel scientific theories. The Court refused to admit expert testimony regarding the systolic blood pressure deception test offered to prove defendant's truthfulness and held that in order to be admissible the scientific principle or discovery must have "gained general acceptance in the particular field in which it belongs." *Id. at 1013-14*. The Court of Appeals of Maryland adopted the *Frye* standard in *Reed v. State, 283 Md. 374, 391 A.2d 364 (1978)* when the Court addressed the admissibility of expert testimony interpreting voiceprint spectrograms that compared the defendant's voice to telephone calls made by an alleged rapist. *Id. at 375-76*. The Court held the testimony to be inadmissible as the application of novel scientific techniques must be reliable and general acceptance within the relevant scientific community demonstrates that reliability. The Court found that voiceprint spectrograms were not generally accepted within the relevant scientific community and excluded the evidence. *Id. at 399*.

Although no Maryland Court has addressed whether the DRE Protocol is a "scientific" test subject to a Frye-Reed challenge, a number [*28] of state courts have held that the *Frye* test is not needed in DRE situations at all since the testimony being offered is not based on new or novel scientific principles. In *State v. Klawitter, 518 N.W.2d 577 (Minn. 1994)*, the Minnesota Supreme Court allowed a DRE. to testify about his observations, and opinion as to whether a suspect was under the influence of drugs The Court concluded that the DRE protocol was not subject to the Frye test because it "is not itself a scientific technique but rather a list of the things a prudent, trained and experienced officer should consider before formulating or expressing an opinion whether the subject is under the influence of some controlled substance."[3] Likewise, in *Williams v. State, 710 So.2d 24 (Fla. Dist. Ct. App. 1998)*, the Florida Court of Appeals held that most of the DRE testimony was not scientific, and thus a Frye hearing was unnecessary. The Court said, "Objective observations based on observable signs and conditions are not classified as 'scientific' and thus constitute admissible testimony [without a *Frye* hearing]."[4] Similarly, in *Utah v. Layman, 953 P. 2d 782 (Utah. App. 1998)*, the Court permitted a DRE to testify as to his opinion [*29] of intoxication under the rationale that it was not scientific evidence, but rather "an expert's personal observations and opinions based on his or her education, training, and experience."

3 Although the Court held that the DEC Program was not a scientific technique, it did rule that components of the program were scientific in nature and as such subject to a *Frye* challenge.

4 The *Williams* Court concluded that nystagmus and lack of convergence tests were scientific in nature but were not "new or novel" in Florida and therefore not subject to a *Frye* challenge.

The purpose of the *Frye* test is to ensure that the evidence presented will be reliable. In failing to apply the test the *Klawitter, Williams* and *Layman* courts failed to ensure that the DRE protocol is reliable.

In *State v. Sampson, 167 Ore. App. 489, 6 P. 3d 543 (Ore. Ct. App. 2000)*, the Oregon Court of Appeals first addressed the issue of whether the DRE testimony was scientific evidence and, after concluding that it was, applied a modified *Daubert* test consisting of seven steps and found the testimony to be admissible.

The *Sampson* Court concluded that "the relevant scientific community consists of physicians, toxicologists, and vision experts, each [*30] of whose fields have studied the protocol extensively." (Id. at 224)

The Court failed to name any organization within the scientific community that endorses the DRE protocol and rested its conclusion upon the testimony of one of the State's witnesses who stated that "the protocol is accepted...by those people who understand what the program is are in a position to evaluate it" and ignored the defendant's two witnesses, a medical doctor who specializes in toxicology and a medical doctor who specializes in treating addiction. Both of those witnesses testified that the scientific community had not accepted the protocol. (Id. at 225-228)

All three of Defendants' three experts. Dr. Janofsky, Dr. Adams, and Dr. Gengo, testified that the DRE protocol and matrix are not generally accepted in the fields of medicine including specifically pharmacology, neurology, ophthalmology and psychiatry.

In *Oregon v. Aman, 194 Ore. App, 463, 95 P.3d 244* (2004), the Court noted that while it previously ruled the 12-step DRE protocol is "valid scientific evidence" it had cautioned that "without the corroborating evidence of the urinalysis called for in the twelfth step, the DRE protocol cannot be considered complete." Id. at 247. [*31] The Court ruled that "an incompletely administered DRE protocol is not, itself, admissible as scientific evidence." Id. at 249.

This ruling clarifies the *Sampson* opinion in that the Court reveals that its previous admission of the DRE opinion was entirely based on the assumption that the introduction of sufficient toxicological confirmation would accompany any testimony regarding the officer's observations.

In *State v. Baity, 140 Wn.2d 1, 991 P.2d 1151 (Wash. 2000)*, the Supreme Court of Washington analyzed the DRE evaluation under the Frye test holding that the DRE evaluation taken as a whole presented an issue of novel scientific evidence and met the general acceptance standard. The Court found that the evidence does have a scientific aspect which "tends to cast a scientific aura about the DRE's testimony requiring its assessment under *Frye*." The Court defined the relevant scientific community as the National Highway Traffic Safety Administration (NHTSA), the International Association of Chiefs of Police (IACP), the American Bar Association, and the American Optometric Association had generally accepted the DRE evaluation. (Id. at 126) The Court held that the DRE evidence was admissible scientific [*32] evidence and properly qualified DREs may testify as experts.

However, the Court erred in defining the relevant scientific community. NHTSA and the IACP are long-time proponents of the DRE program and have a vested interest in its acceptance and use. "General scientific recognition may not be established without the testimony of disinterested and experts whose livelihood is not intimately connected with the program." *People v. Barbara, 400 Mich. 352, 255 N.W.2d 171, 180 (Mich. 1977)*. Although the members of the American Optometric Association are eye specialists and would understand certain steps in the evaluation, they are not physicians.

In *Schultz v. State, 106 Md. App. 145, 664 A.2d 60 (1995)*, the Horizontal Gaze Nystagmus ("HGN") test was scrutinized under *Frye/Reed* although this test which is given as an indicator of alcohol abuse had been admitted many times in DWI cases. The Court in deciding it would apply *Frye/Reed* to the test noted that "[i]n determining whether a scientific technique is 'new'...long-standing use by police officers seems less significant a factor than repeated user study, testing, and confirmation by scientists or trained technicians" and made, a finding that HGN passed *Frye/Reed* for determining [*33] the presence of alcohol. *Id. 162*. In *Blackwell v. State, 408 Md. 677, 971 A.2d 296 (2009)*, the Court held that HGN is a scientific test accepted in Maryland for determining alcohol use. However, police officers cannot use HGN. to provide a specific blood alcohol content. *See, Wilson v. State, 124 Md. App. 543, 723 A.2d 494 (1999)*.

The DRE protocol includes field sobriety tests such as HGN, One-Leg Stand, and Walk and Turn, but no Maryland court has permitted those tests to be used for proving drug impairment. The DRE protocol uses scientific procedures and techniques and uses that data to determine the cause of the physiological symptoms observed. These procedures and techniques include, *inter alia*: blood pressure, pupil reactivity to light, pupil dilation and constriction, horizontal and vertical nystagmus, pulse rate, body temperature, and muscle tone.

Dr. Adams testified that in the Shinar Study (Defense Exhibit 4) DREs found HGN in categories where a drug could not even cause HGN and in his expert opinion that demonstrates that you "need a properly performed test and you need to understand nystagmus and ask these other eleven questions[5] to be able to determine where that nystagmus came from." (Tr. 9/29/10 at [*34] 57-58)

5 See eleven questions the examiner must consider before diagnosing nystagmus at p. 15 of this Memorandum Opinion and Order.

Dr. Janofsky testified that vital signs are not something the medical community uses to show drug impairment and he knows of no one in the medical field that does use vital signs as an indicator. (9/27/10 at 51) He further testified that "it would be malpractice for a physician to rely on clinical data alone...you cannot make a diagnosis of impairment or intoxication based on clinical data alone...you must have confirmatory testing." (Tr. 9/23/10 at 227) The National Academies of Science in 2009 published its findings on various aspects of forensic science in *Strengthening Forensic Science in the United States: A Path Forward*, National Research Council of the National Academies, 2009 (hereafter "WAS Report"). The NAS report found that "there is a notable dearth of peer-reviewed, published studies establishing the scientific basis and validity of many forensic methods. (Id. at 8) The NAS report contained the following recommendation:

> The degree of science in a forensic science method may have an important bearing on the reliability of forensic evidence in criminal [*35] cases. There are two very important questions that should underlie the law's admission of and reliance upon forensic evidence in criminal trials: (1) the extent to which a particular forensic discipline is founded on a reliable scientific methodology that gives it the capacity to accurately analyze

> evidence and report findings, and (2) the extent to which practitioners in a particular forensic discipline rely on human interpretation that could be tainted by error, the threat of bias, or the absence of sound operational procedures and robust performance standards. These questions are significant. **The goal of law enforcement actions is to identify those who have committed crimes and to prevent the criminal justice system from erroneously convicting the innocent. So it matters a great deal whether an expert is sufficiently reliable to merit a fact finder's reliance on the truth that it purports to support**.

Id. at 87 (Emphasis supplied).

Dr. Janofsky testified that peer reviewed and published literature must be performed before a " technique like the DRE would be accepted among the medical and scientific communities. He testified that the Heishman study 1, Heishman Study 2, the Shinar Study [*36] and the Schectman Study represent the extent of the peer reviewed' and published literature that exists on the subject of the DRE protocol. He testified that these studies did contain the necessary information for specificity and sensitivity ratios and were conducted in a double-blind fashion. He further testified that the Heishman, Shinar and Schectman studies conclusively show that the DRE, when tested and looked at appropriately, is not an accurate predictor of the presence of drugs and the four studies conclusively show that a police officer's predictions are either no better than chance or may be slightly better than chance or worse than chance. (Tr. 9/23/10 at 212) Dr. Janofsky noted he could find no scientific literature which correlates nystagmus, pupil size, reaction to light, lack of convergence, pulse rate, blood pressure, or body temperature (all separate components of the DRE) with driving impairment while intoxicated on drugs. (Dr. Janofsky Report, p. 7)

Dr. Citek acknowledged that confirmation is a form of tunnel vision when someone seeks out evidence to confirm their hypothesis and that in the non-peer reviewed studies the officers were told the drug a person took and [*37] as a result "it is likely that they will reach the result in terms of what they are actually impaired by." (Tr. 9/20/10 at 165-66)

Under the *Frye-Reed* standard the drug recognition protocol is a new and novel technique because it purports to create a protocol for police officers to render a medical diagnosis. When the relevant scientific community is properly defined to include disinterested medical professionals it is clear that the drug recognition protocol is not generally accepted as reliable.

2. *Md. R. 5-702*

Expert testimony discussing novel scientific theories must meet the *Frye/Reed* standard in' addition to the *Md. R. 5-702* requirements to be admissible. Expert testimony addressing non-novel scientific evidence, however, must only meet the requirements of *Md. R. 5-702*. *United States v. Horn, 185 F. Supp. 2d 530, 547-48 (D. Md. 2002)*(Under Maryland evidence law, the *Frye/Reed* test applies only to introduction of [novel] scientific evidence, and *Rule 5-702* alone covers all other types of expert opinion testimony.)

Md. R. 5-702 provides:

> Expert testimony may be admitted in form of an opinion or otherwise if the court determines that the testimony will assist the trier of fact to understand [*38] the evidence or to determine a fact in issue. In making that determination, the court shall determine (1) whether the witness is qualified as an expert by knowledge, skill, experience/ training, or education, (2) the appropriateness of the expert testimony on the particular subject, and (3) whether a sufficient factual basis exists to support the expert testimony.[6]

6 In *Daubert v Merrell Dow Pharmaceuticals, Inc., 509 U.S, 579, 113 S. Ct. 2786, 125 L. Ed. 2d 469* (1993), held that the *Frye* standard had been superseded by *Federal Rule of Evidence 702*. *See also Kumho Tire Company, Ltd. v. Carmichael, 526 U.S. 137, 119 S. Ct. 1167, 143 L. Ed. 2d 238 (1999)*. However, when the Maryland Rules of Evidence were drafted, the Committee specifically stated that *Maryland Rule 5-702*, although patterned on the Federal Rule, was not intended to overrule *Reed v. State, 283 Md. 374, 391 A.2d 364* and the *Frye-Reed* standard is followed in Maryland to determine the admissibility of scientific evidence.

Applying *Md. R. 5-702* to the proposed DRE testimony, the Court finds that a drug recognition expert is not sufficiently qualified to render an opinion, that the testimony is not relevant, and the probative value of the evidence is substantially outweighed by its prejudicial effect.

IV. [*39] **Conclusion**.

Based upon the Court's review of ten days of expert testimony, arguments of counsel, case law, exhibits, and the written closings of counsel, the Court makes the following:

Findings of Fact

The DRE Protocol fails to produce an accurate and reliable determination of whether a suspect is impaired by drugs and. by what specific drug he is impaired.

The DRE training police officers receive does not enable DREs to accurately observe the signs and symptoms of drug impairment, therefore, police officers are not able to reach accurate and reliable conclusions' regarding what drug may be causing impairment.

Conclusions of Law

The State failed to prove by a preponderance of the evidence that the drug evaluation and classification program is not new or novel and is generally accepted within the scientific community and, therefore, it is subject to analysis under *Frye v. United States* and *Reed v. State*.

The drug evaluation and classification program does not survive a *Frye/Reed* challenge because it is not generally accepted as valid and reliable in the relevant scientific community which includes pharmacologists, neurologists, opthamologists, toxicologists, behavioral research psychologists, [*40] forensic specialists and medical doctors.

For the reasons set forth above, the Court hereby grants Defendants' Motion To Exclude The Drug Recognition Expert Protocol and Drug Recognition Expert Opinion.

Order

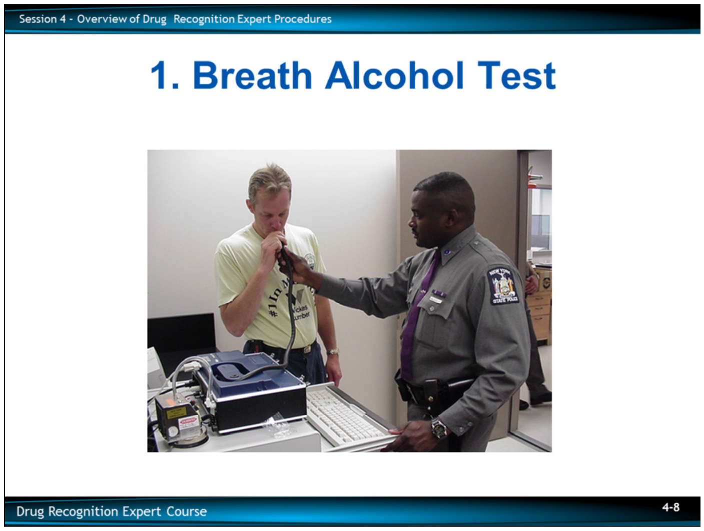
It is, by the Circuit Court for Carroll County, this 5th day of March, 2012,

ORDERED, that Defendants' Motion To Exclude The Drug Recognition Expert Protocol and Drug Recognition Expert Opinion be, and it hereby is, granted.

/s/ Michael M. Galloway

JUDGE MICHAEL M. GALLOWAY

EXHIBIT B

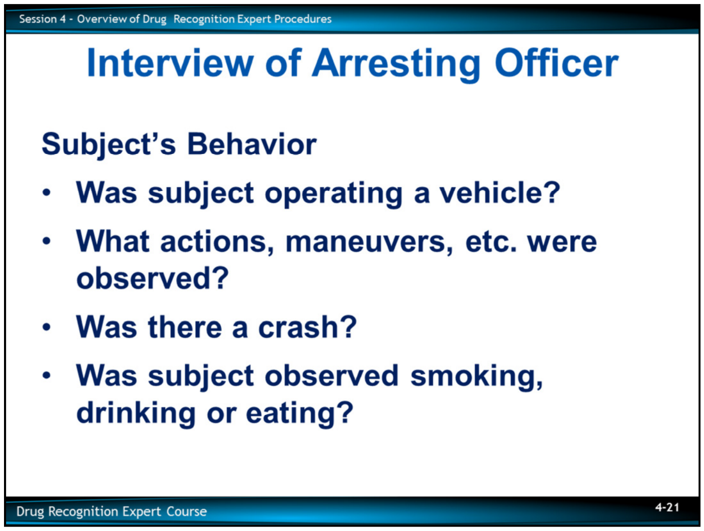


Breath Alcohol Test
The Breath Alcohol Test is needed to determine BAC.

The purpose of the breath test is to determine whether the specific drug, alcohol, may be contributing to the impairment observed in the subject.

Obtaining an accurate measurement of BAC enables the DRE to assess whether alcohol may be the sole cause of the observable impairment or whether it is likely some other drug or drugs, or other complicating factors, are contributing to the impairment.
Remind participants many subjects who are under the influence of drugs other than alcohol also have alcohol in their system.

EXHIBIT C



B. <u>Interview of the Arresting Officer</u>

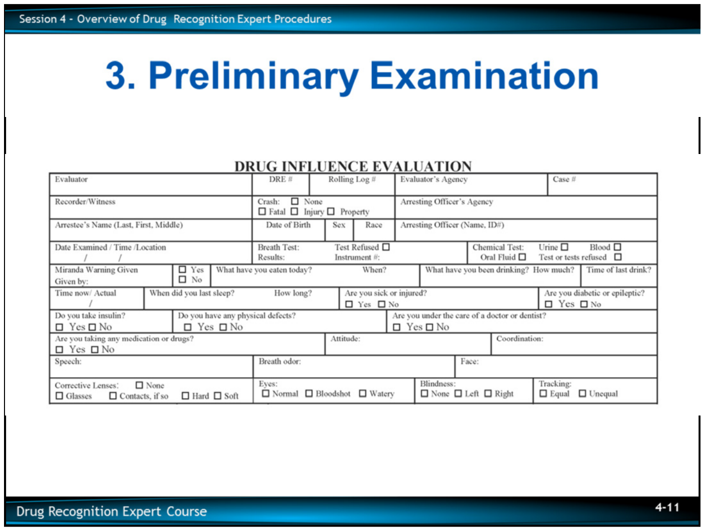
The purpose of the interview of the arresting officer is to obtain a summary of the subject's actions, behaviors, etc. that led to the arrest and the suspicion that drugs other than alcohol may be involved. ***Emphasize DREs should form the habit of posing explicit questions to arresting officers using a systematic process. A cursory or open-ended interview (e.g., "What do we have here?") may fail to elicit some relevant information because arresting officers won't always know what is relevant to a drug evaluation.***

Interview Behavior

Issues concerning the subject's behavior:

- Was the subject operating a vehicle?
- What actions, maneuvers, etc. were observed?
- Was there a crash?
    - If yes, was the subject injured?
- Was the subject observed smoking, drinking or eating?

EXHIBIT D

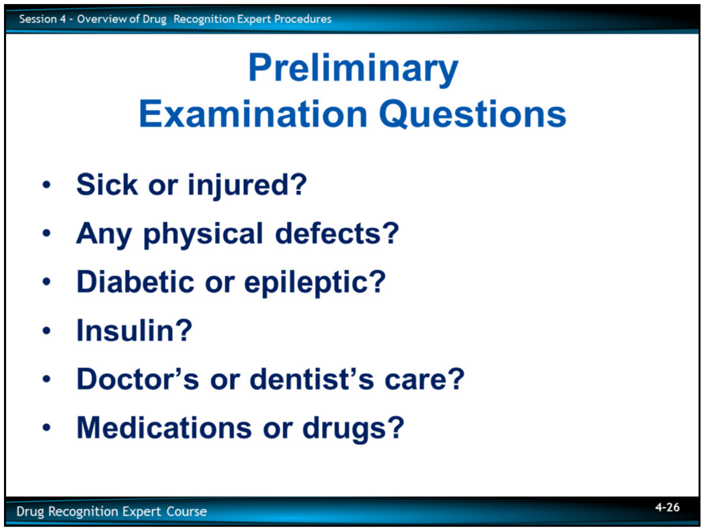


The preliminary examination consists of a series of questions dealing with:

- Possible injuries or medical problems
- Observations of the subject's face, speech, and breath
- Pupil size and tracking ability
- Initial checks of the subject's eyes
- Initial examination of the subject's pulse

While you are assessing the subject's tracking ability, you can also perform a preliminary assessment of whether any nystagmus is present in the subject's eyes. In particular, an initial estimation of the angle of onset can be made. The approximate angle of onset may help to determine whether the subject has consumed some drug other than alcohol. This is not a complete Horizontal Gaze Nystagmus (HGN) test at this time. An entire HGN test will be conducted in the next step. ***Emphasize courts generally accept these questions as not being in conflict with the subject's Constitutional rights. However, the participants must comply with their own department's policies as to whether they should advise the subjects of their Constitutional rights before asking these questions.***

EXHIBIT E



Preliminary Examination Questions

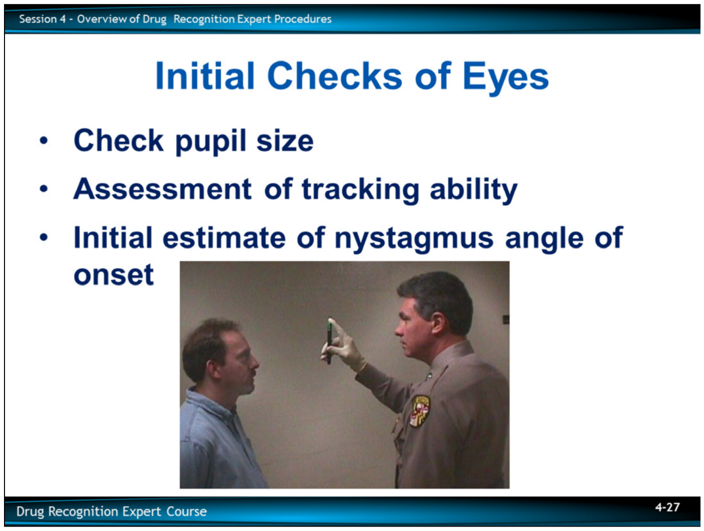
The questions deal with injuries or medical problems the subject may have. They include:

Point out these questions are incorporated into the Drug Influence Evaluation Form which the participants will use during all of their practice sessions.

Briefly discuss the relevance of each question**.**

- Are you sick or injured?
- Do you have any physical defects?
- Are you diabetic or epileptic?
- Do you take insulin?
- Are you under a doctor or dentist's care?
- Are you taking any medications or drugs?

EXHIBIT F



Initial Checks of the Eyes
The initial checks of the subject's eyes include several particularly important steps, which include:

Check of the Size of Each Pupil
The initial examination of the eyes may reveal signs of injury or illness. A difference in pupil size of greater than 0.5 mm may indicate an injury or existing medical condition.
Point out if the two pupils are of unequal size, this may indicate the subject is suffering from a head injury, brain tumor, or other condition that may require prompt medical attention.
Also point out the influence of certain categories of drugs may be present if the pupils are dilated or constricted.

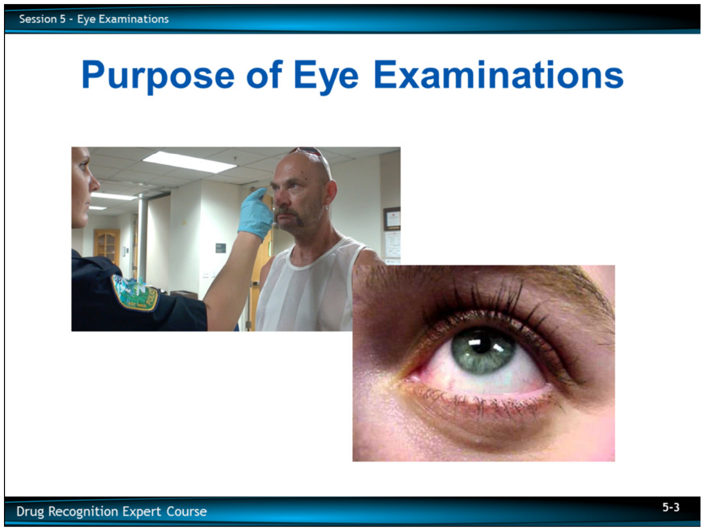
Assessment of the Ability of the Eyes to Track a Moving Object
Demonstrate how to use a stimulus to assess the ability of eyes to track a moving object.

The presence of nystagmus indicates the possible presence of certain categories of drugs.
Point out if the two eyes do not exhibit the same tracking ability, this too may indicate a head injury or other medical problem.

Initial Estimation of the Angle of Onset of HGN

The approximate angle of onset may indicate the presence of some drug other than alcohol.
Point out certain categories of drugs cause HGN. For example, this will be true of CNS Depressants, Inhalants, and Dissociative Anesthetics.

EXHIBIT G



A. <u>Purpose of the Eye Examinations</u>

The principal purpose of all of the eye examinations is to obtain articulable facts indicating the presence or absence of specific categories of drugs.

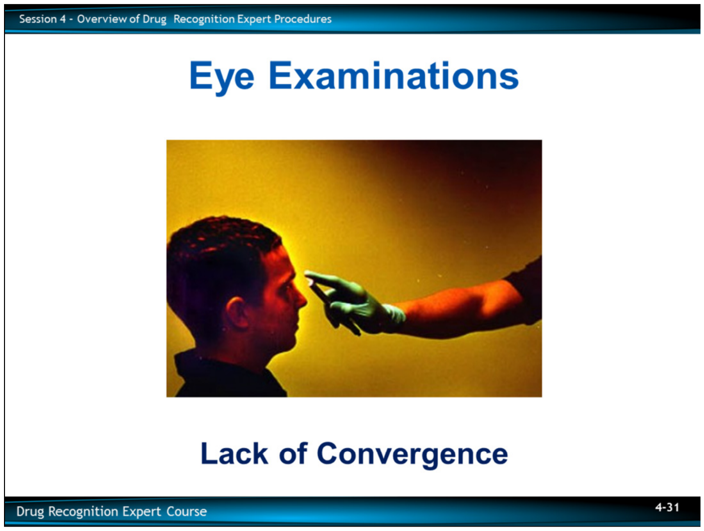
Certain drug categories usually cause the eyes to react in specific ways. Other drug categories usually do not cause those reactions.

The tests of Horizontal Gaze Nystagmus (HGN) and Vertical Gaze Nystagmus (VGN) provide important indicators of the drug categories that may or may not be present.
Ask participants: "What causes HGN?" Alcohol and certain other drugs will cause HGN.

If HGN is observed, it is likely the subject may have ingested alcohol or another CNS Depressant, an Inhalant, a Dissociative Anesthetic, or a combination of those.

If VGN is observed, the implication may be the subject ingested a large dose of alcohol for that individual, a Dissociative Anesthetic, such as PCP, or high doses of other Depressants or Inhalants.
Point out it is very unlikely a subject would exhibit VGN without also exhibiting HGN.

EXHIBIT H



Illustrate on the dry erase board or easel/easel pad different examples of LOC.

Lack of Convergence (LOC)

Point out LOC is the inability of the eyes to draw in toward the center (cross) while fixating on a stimulus being moved in toward the bridge of the nose.

LOC is checked by first getting the subject to focus on and track the stimulus as it slowly moves in a circle in front of the subject's face.

Point out the circular motion (either left or right) serves to demonstrate the subject is tracking the stimulus.

Demonstrate this circular motion using the participant volunteer.

Then, the stimulus is slowly pushed in toward the bridge of the subject's nose and held for approximately one (1) second.

Demonstrate using the participant volunteer.

Remind participants that it is a good idea to conduct the LOC test twice to confirm the results.

Point out the stimulus does not actually touch the subject's nose, stopping approximately, but no closer than, 2 inches from the nose.

Under the influence of certain types of drugs, the eyes may not be able to converge.

Point out many people may not be able to converge their eyes.

Remind participants subjects who normally wear reading glasses should be afforded the opportunity to wear their glasses during the LOC test if available.

Excuse the participant volunteer and thank him or her for participating.

Solicit participants' comments and questions concerning the Examinations of the Eyes.

EXHIBIT I

Drunk Driving Def. § 5.06

Aspen Publishers | 9th Edition

Drunk Driving Defense
Lawrence Taylor, J.D. and Steven Oberman, J.D.

Part II: Evidence

Chapter 5: Field Evidence

§ 5.06 DRUG (RECOGNITION) EVALUATION AND CLASSIFICATION

The term "DRE" is used to designate the actual evaluation performed by an individual who is specially trained to conduct evaluations of suspected drug-impaired drivers.[411] In some law enforcement agencies, the term stands for "Drug Recognition Expert," in others it means "Drug Recognition Examiner," and in others, "Drug Recognition Evaluator." In addition, some agencies use the term "DRT"--"Drug Recognition Technician," and others use "DRS"--"Drug Recognition Specialist." According to the United States Department of Transportation National Highway Traffic Safety Administration (NHTSA), all of these terms are acceptable and synonymous.[412] NHTSA itself defines DRE as "Drug Recognition Expert" and offers a Drug Recognition Expert 7-Day School as a step in qualifying to serve as a Drug Recognition Expert.[413]

The Drug Evaluation and Classification (DEC) Program is a national effort to deter impaired driving by increasing the likelihood that people who drive under the influence of drugs will be detected, caught, convicted, and punished. The DEC Program is sponsored by NHTSA. It is administered and coordinated by the International Association of Chiefs of Police (IACP), and supported by each state's highway safety offices, as well as state and local law enforcement agencies. It is endorsed by the U.S. Department of Justice, the American Bar Association, and the National Commission Against Drunk Driving, to name just a few. Because the DEC training itself is lengthy and somewhat technical, the authors will not attempt to review all of the educational materials in this text. Instead, the authors intend to provide an overview of this subject matter. We further recommend taking the time to study the Drug Recognition Expert Course Participant Manual, available from NHTSA,[414] and attending a course from a qualified instructor.

[A] History of the DEC Program

According to the 2018 DRE Course Participant Manual, The Drug Evaluation and Classification program was developed by personnel of the Los Angeles Police Department (LAPD).[415] The initial impetus for the program stemmed from the frequent encounters, by experienced traffic enforcement officers, with drivers who were clearly impaired but whose blood-alcohol concentrations were very low or zero. The logical suspicion was that these drivers were under the influence of drugs other than alcohol, but obtaining convincing evidence to confirm that suspicion was difficult.

Occasionally, officers succeeded in having physicians examine their low BLAC subjects, sometimes resulting in a medical diagnosis of drug influence. However, medical personnel typically receive little or no training in the recognition of specific signs of drug impairment, particularly at street level doses; therefore, they often were unable or reluctant to offer a judgment about a subject's condition. As a result, many drivers who almost certainly were under the influence were not prosecuted or convicted.

Two LAPD sergeants were instrumental in organizing a program to help police officers develop the skills needed to perform their own assessments of drug-impaired drivers. One was Dick Studdard, a traffic officer; the other was Len Leeds, a narcotics officer. They undertook independent research by consulting with physicians, enrolling in relevant courses, studying text books and technical articles, etc. Furthermore, they secured management level support within the LAPD to continue and accelerate the research and development effort. With the assistance of many others, Sergeants Studdard and Leeds ultimately succeeded in developing a drug recognition program based on a three-step process:

STEP ONE

Verify that the subject is impaired, and verify that the subject's blood alcohol concentration is not consistent with the degree of impairment that is evident.

STEP TWO

Determine whether the impairment is drug or medically related (i.e., injury or illness).

STEP THREE

Use proven diagnostic procedures to determine the category (or combination of categories) of drugs that is the likely cause of the impairment.

In 1979, the drug recognition program received the official recognition of the LAPD.[416] Subsequently, a laboratory validation study was conducted by researchers from Johns Hopkins University in Maryland.[417] NHTSA followed up the laboratory study by sponsoring a Field Validation Study in Los Angeles. Arrangements were made to have an independent laboratory analyze blood samples drawn from persons actually arrested on suspicion of drug-impaired driving. Any subject who was involved in a crash was excluded from the study, since injuries could have confounded the drug examination. Likewise, any subject who refused to submit to the blood test was excluded, since there would have been no way to substantiate or refute the DRE's conclusions.[418]

The results of the laboratory study are quite interesting. Only one of the 173 subjects was found to have no alcohol or other drug. Only 10 others were found to have alcohol only. Of the 173 subjects, 125, or 72%, had ingested two or more drugs other than alcohol.[419] The Laboratory Validation Study concluded that the DREs were “excellent” (95% accurate) in identifying drug-free subjects as “not impaired.”[420] Similarly, they were “excellent” in identifying the high-dose subjects.[421] The manual is quick, however, to point out that the DREs were “less successful” (17.5% to 32.5% accurate) in identifying subjects who received only weaker doses of the studied drugs.[422]

As noted above, defense counsel should take special note of the exclusion of subjects involved in a crash or who refused a blood test.[423] Should your client fall into one of these categories, the conclusions of a Drug Recognition Expert may be of reduced significance.

Drug Evaluation and Classification (DEC) pilot programs were launched by NHTSA in 1987 and have since expanded across the United States and Canada.[424] The DEC program is currently managed and coordinated by the International Chiefs of Police (IACP), which also receives support from the NHTSA and the U.S. Department of Transportation.[425]

One may ask, why is the DEC program necessary if the subject is obviously impaired and the alcohol level is insufficient to account for that impairment? In that circumstance, why doesn't the officer simply obtain a blood sample and have a drug analysis performed? The manual itself answers these questions as follows in detailing the need for a reliable standardize assessment procedure:

• The officer may be called upon to submit evidence of an articulable suspicion of drug influence to support a request for a chemical test of the subject;

• Some courts or motor vehicle hearings officers may find a low BAC result, by itself, does not provide adequate basis for requesting the subject to submit to a second chemical test;

• The subject may refuse to submit to the chemical test, denying the prosecution of scientific evidence of drug influence, hinging a conviction or acquittal on the officer's observations and expertise as a DRE;

• Chemical tests usually disclose only that the subject has used a particular drug recently;
o The chemical test usually does not indicate whether the drug is psychoactive at the time of arrest;

o Thus, the DRE procedures are needed to establish the subject not only has used the drug, but also that he or she is under the influence;

• It can be expensive and require a large sample of blood or urine to perform a broad analysis for any or all drugs;
o Practical constraints require that the officer be able to point the laboratory technician toward those types of drugs most likely to be found in the sample;

• It is always possible that a person suspected of drug impairment is actually suffering from some medical problem; and

• If a sample is collected and the subject is not examined by someone who is qualified, evidence of medical problems may not come to light until it is too late.[426]

Those who are interested in learning more about the development of the DRE validation studies may wish to review the 1985 NHTSA Final Report, Identifying Types of Drug Intoxication: Laboratory Evaluation of a Subject Examination Procedure.[427] This study concluded that:

1) For certain drug-dose combinations, most subjects were rated as intoxicated, but for other combinations, most were not;

2) Subjects rated as intoxicated had almost always received a drug, and raters were quite accurate in specifying which drug had been given to the subjects they rated as intoxicated; and

3) Subjects who did not receive a drug were almost always rated as not intoxicated.

This publication was soon followed by the *Field Evaluation of the Los Angeles Police Department Drug Detection Procedure* in 1986.[428] In this study, blood samples were obtained from 86% of the suspects believed to be under the influence of drugs. No blood samples were obtained from suspects not appearing to be under the influence of drugs. The reported results showed that:
1) When officers claimed drugs other than alcohol were present, they were detected 94% of the time;

2) Officers were able to correctly identify at least one drug other than alcohol in 87% of the evaluated suspects, of which most had consumed multiple drugs; and

3) When the DREs identified their suspects as impaired by a specific drug, that drug was detected in the suspect's blood 79% of the time.

Nearly a decade later, Drs. Eugene Adler and Marcelline Burns prepared a Final Report to the Arizona Governor's Office of Highway Safety titled *Drug Recognition Expert (DRE) Validation Study*.[429] This study concluded that the DRE program, supported by toxicology laboratory results, is a valid method for detecting and classifying drug-impaired individuals. It also noted that 8% of the 500 suspects were predicted to have consumed drugs, but none were found in the laboratory tests.[430] When combining the false positives with the failure of the DRE to identify a suspect who had consumed drugs, an accuracy rate of 85% was reached.[431]

[B] Overview of Components of the Drug Evaluation and Classification (DEC) Procedure

The DEC procedure is intended to be a systematic and standardized method of examining a subject to determine:[432]
(1) Whether the subject is impaired; and if so,

(2) Whether the impairment relates to drugs or a medical condition; and if drugs,

(3) The category or combination of categories of drugs that are the likely cause of the impairment.

It is a systematic process because it is based on a complete set of observable signs and symptoms that are known to be reliable indicators of drug impairment. A DRE should never reach a conclusion based on any one element of the evaluation, but instead on the totality of facts that emerge.

The facts are obtained from careful observations of the subject's:
• appearance

• behavior

• performance of psychophysical tests

• eyes

• vital signs

• any other evidence

The evaluation is standardized because DRE officers should perform it the same way every time. By conducting a standardized and systematic evaluation, the DREs should reduce mistakes and help promote and maintain professionalism and consistency among DREs. The standardized and systematic evaluation is broken down into 12 major components or steps. The checklist on the next page lists the steps in the sequence in which they are performed. DREs refer to the checklist every time they conduct an evaluation.

As noted by the Supreme Court of Washington,

> "To be certified as a DRE, an officer must complete a three-phase program of instruction. First, the officer must attend a 16-hour "preschool," which involves an overview of the DRE program, and instruction on the seven drug categories and basic drug terminology. Second, the officer must complete a 56-hour DRE school program. This program consists of 30 modules of instruction, including an overview of the development and validation of the drug evaluation process, and sessions on each drug category. In addition to classroom instruction, the program requires practical field training. Additionally, the officer must pass a written examination before beginning the next phase of training. Finally, the officer begins certification training. Certification requires the officer participate in a minimum of 12 complete examinations under the supervision of a trained DRE instructor. Of those 12 evaluations, the officer must identify an individual under the influence of at least 3 of the 7 drug categories. The officer is required to obtain a minimum 75 percent toxicological corroboration rate. The officer must then pass another written examination and a separate skills demonstration examination performed in front of two DRE instructors before he or she becomes certified as a DRE. Finally, the officer must maintain an up-to-date resume or curriculum vitae.

Additionally, a DRE must be recertified every two years. During that time period, the DRE is required to conduct four hands-on evaluations and to attend eight hours of in-service training."[433]

It is important to emphasize that, "[a] DRE's opinion is based not on one element of the test, but on the totality of the evaluation. When in doubt, the DRE must find the driver is not under the influence."[434]

Specifically, the officer must conduct a 12-step procedure before formulating his or her final opinion. These 12 steps are indicated below.

INTERNATIONAL ASSOCIATION OF CHIEFS OF POLICE

DRUG EVALUATION AND CLASSIFICATION PROGRAM

DRUG INFLUENCE EVALUATION CHECKLIST[435]

1. Breath alcohol test

2. Interview of arresting officer

3. Preliminary examination and first pulse

4. Eye examinations

5. Divided attention tests:
• Romberg balance

• Walk and turn

• One-leg stand

• Finger to nose

6. Vital signs and second pulse

7. Dark room examinations and ingestion examination

8. Check for muscle tone

9. Check for injection sites and third pulse

10. Interrogation, statements, and other observations

11. Opinion of evaluator

12. Toxicological examination

Interestingly, the 2007 DRE Student Manual notes that, "there may be cases in which the DRE is unable to complete each step of the evaluation due to circumstances beyond his or her control such as injury to the subject, uncooperativeness of the subject, or equipment failure. In such cases, the DRE may still be able to form an opinion based on the evidence that he/she is able to observe and document," citing *Cammack*.[436] The 2015 and subsequent manuals, citing the same case, also note that "a DRE need not complete the entire 12-step evaluation for an opinion to be admissible so long as there is sufficient admissible evidence."[437] Authors' Note: Common incidences of uncooperativeness occur when the suspect refused to take the field sobriety tests or the chemical tests. Although not noted in the DRE manual, it is important to note that the *Cammack* case is unpublished, and accordingly must not be cited as precedent, except in limited circumstances.

It should be noted, that another unreported case, this one from the State of Washington also holds that the DRE need not complete the entire 12-step evaluation before testifying as to his opinion. This case is easily distinguishable. In *State v. Tucker*, the Washington Court of Appeals noted that the officer explained on cross-examination that he did not go through the entire procedure because Tucker had already told him that he had taken at least two of his medications on the day of the accident--so it was unnecessary to do a full evaluation.[438]

While the unreported case of *Cammack*[439] authored by the Minnesota Court of Appeals does hold that the officer need not complete the entire 12-step evaluation process, it appears the *Cammack* court misinterpreted the holding of the Minnesota Supreme Court case of *State v. Klawitter*,[440] upon which it based its opinion.

The *Klawitter* opinion states:

> In summary, it seems to us that the use of a standard 12-step procedure for recognizing drug impairment leads to greater accuracy and consistency in the opinions of various officers than is likely if each officer develops her or

> his own format for deciding whether the suspect is drug impaired. We agree with the trial court that the officer should be allowed to give an opinion based on the officer's training and experience and his or her observations following the 12-step drug recognition protocol, as long as (a) there is sufficient foundation for the specific opinion expressed, (b) the state does not attempt to exaggerate the officer's credentials by referring to the officer as a "Drug Recognition Expert" or to unfairly suggest that the officer's opinion is entitled to greater weight than it deserves, and (c) the evidence otherwise survives Minn. R. Evid. 403 analysis. We add only that it should be obvious that the mere fact that such opinion testimony is admitted does not necessarily mean that such testimony by itself will be sufficient to support a guilty verdict.[441]

The *Klawitter* case is well worth reading in its entirety. The opinion summarizes the testimony of the multiple experts who testified for both the prosecution and the defense. If nothing else, be certain to read the dissenting opinion. Indeed, it is so important that a large portion of it is reprinted below.

> "In the criminal context with its constitutional implications, it is not too much to require that expert testimony be accurate, valid, and reliable. No one doubts that an officer's assessment of drug impairment based on the personal observations and medical or scientific tests of the DRE protocol is expert testimony. Therefore, the DRE protocol must be tested for both its validity/accuracy, the ability to measure what it is supposed to measure, and its reliability, the consistency in obtaining the same results each time the procedure is performed.

The DRE protocol can be tested, but it has not yet been tested properly. None of the four studies the trial court cites to support its conclusion that the DRE protocol is reasonably reliable in determining whether an individual is impaired by drugs prove that the DRE is a valid or reliable protocol for predicting drug impairment. Evidence introduced at the trial court hearing indicated that none of the studies administered the DRE protocol in a blind fashion so as to insure their validity. In each study the DRE knew in advance that the suspect had already admitted to using drugs or that drugs or drug paraphernalia were found on or near the suspect at the time of his arrest--thus unblinding the study and tainting the DRE's evaluation. None of the studies provided for more than one DRE to evaluate the same subject, making it impossible to compare and judge the accuracy of the evaluations. None of the studies measured evaluation under the DRE protocol against the correct standard of ability to safely operate a motor vehicle-Minnesota law prohibits driving a motor vehicle while impaired by a controlled substance; it does not prohibit driving a motor vehicle with drugs present in one's urine. All experts agreed that the mere presence of drugs in a person's system does not mean the person is impaired."[442]

Since the *Klawitter*[443] opinion, however, the results of another study were published in 1996.[444] The primary goal of the 1996 study was to determine the validity of the variables of the DEC evaluation in predicting whether research volunteers had been administered ethanol, cocaine, or marijuana; a secondary goal was to determine the accuracy of trained police officers (DREs) in detecting whether subjects had been dosed with these drugs. Community volunteers with histories of drug use received various amounts of ethanol, cocaine, and marijuana in a double-blind, randomized, within-subjects design. A single dose or placebo was administered during each of nine experimental sessions. Blood samples were obtained before and periodically after dosing. With the exception of marijuana, plasma drug concentration was at or near the observed maximum during the drug evaluation and classification procedure.

The ability of the DEC evaluation to predict the intake of these substances was optimal when using 17 to 28 variables from the evaluation. When drug evaluation classifiers concluded impairment was due to drugs other than ethanol, their opinions were consistent with toxicology in 44% of the cases. The scientists concluded that the DEC procedure can be used to accurately predict acute administration of ethanol, cocaine, or marijuana.[445] It was further determined that predictions of drug use may be improved if DREs focus on a subset of variables.[446] This study, which was financially supported in part by NHTSA, provides many bases upon which to attack the validity of the DEC evaluation. Defense practitioners should become familiar with the AAA Foundation study that, evaluated through logistic regression analysis whether the physiological, cognitive and psychomotor indicators from the DRE exam could predict THC concentration above or below a 5 ng/mL threshold and they could not. Additionally, assuming the validity of a 5 ng/mL threshold as defining impaired versus non-impaired subjects, [they] evaluated whether performance on any of the physiological, cognitive or psychomotor indicators correctly assigned the subject to the impaired or non-impaired group. None of the indicators met the 80 percent sensitivity threshold for correctly predicting impairment status.

Analysis of the sensitivity, specificity, and accuracy of various THC concentration threshold suggested the concentration threshold associated with the best sensitivity (80.4%) and accuracy (77.0%) was 1 ng/mL, which also had the lowest specificity (70.2%). Higher THC concentration values reduced sensitivity but increased specificity.[447]

The study concluded that "[t]here [was] no evidence from the data collected, particularly from the subjects assessed through the DRE exam, that any objective threshold exists that established impairment, based on THC concentrations measured in specimens collected from cannabis-positive subjects placed under arrest for impaired driving."[448]

A more recent study entitled, *Cannabis use as a risk factor for causing motor vehicle crashes: a prospective study,* was conducted in British Columbia, Canada.[449] The results of this British Columbia study concluded that in this sample of non-fatally injured motor vehicle drivers, there was no evidence of increased crash risk in drivers who had in their bloodstream δ-9-tetrahydrocannabinol with less than 5 ng/ml and a statistically non-significant increased risk of crash responsibility (odds ratio = 1.74) in drivers who had in their bloodstream δ-9-tetrahydrocannabinol equal to or greater than 5 ng/ml.[450]

Another study, this one funded by the Royal Canadian Mounted Police, was conducted in 2007 to review the existing evaluation studies on the Drug Evaluation and Classification (DEC) program.[451] This study was divided into two categories: (1) laboratory studies and (2) field studies. A classification process was developed using common criteria based upon whether the subject tested positive or negative on a chemical test for drugs and whether the officer classified the subject as positive or negative for drugs. A series of standard measures were used to assess the effectiveness of the program. These standards included Sensitivity, Specificity, False Alarm Rate, Miss Rate, Corroboration, and Accuracy.[452]

This study concluded that,
Laboratory studies do not provide overwhelming support for the accuracy with which officers trained in the DEC program can detect and identify the particular class(es) of drug involved based on psychophysical assessment alone. The detection and identification of the relatively low levels of drugs administered were typically better than chance but many cases were missed. The fact that some drugs were detected with greater accuracy than others suggests that the effects of these substances were more prominently manifested in the symptomology assessed by the DEC procedure. Although field enforcement studies are not as scientifically rigorous as laboratory studies, DEC assessments in an enforcement context have the benefit of information obtained from the arresting officer and from interviews with the suspect. In addition, the drug doses consumed by users are typically much higher than those permitted in controlled laboratory studies. In general, officers trained in the DEC program are able to identify persons under the influence of drugs and to specify the drug class responsible with a degree of accuracy that not only exceeds chance, but in some cases reaches a very high level.[453]

In the development of the DEC curriculum, no studies were conducted to correlate performance on the standardized field sobriety tests with impairment by drugs. However, the NHTSA-standardized field sobriety tests were used by the state police of Victoria, Australia, to test for driving impairment associated with marijuana intoxication rather than alcohol.[454] The study revealed that a positive relationship existed between the dose of marijuana administered and the number of participants classified as impaired based on the field sobriety tests. Interestingly, the police noted a new clue: head movements or jerks (HMJ). In summary, the findings suggested that impaired performance on the standardized field sobriety tests was positively related to the dose of marijuana administered.

In 2013, the Canadian Centre on Substance Abuse conducted a study entitled, *An Examination of the Validity of the Standardized Field Sobriety Test in Detecting Drug Impairment Using Data from the Drug Evaluation and Classification*

Program.[455] This study analyzed the drug categories of CNS stimulants, CNS depressants, narcotic analgesics, cannabis and "no drugs." The conclusions were extremely specific for each type of drug as they related to each of the Standardized Field Sobriety Tests. The findings provide support for the use of the Standardized Field Sobriety Tests as a screening tool to identify persons impaired by CNS stimulants, CNS depressants, narcotic analgesics, and cannabis.

In 2012, an important decision was made by the Circuit Court for Carroll County, Maryland, in the consolidated cases of 26 defendants.[456] The issue before the court was whether the DRE protocol and testimony were admissible in the State of Maryland for the purpose of prosecuting a DUI suspect.

In a multiday hearing, the prosecution presented six experts: Dr. Karl Citek (optometrist and adjunct faculty member of the Institute of Police Technology and Management); Ms. Michelle Spirk (biochemist employed with the Arizona Department of Public Safety); Mr. William Tower III (law enforcement liaison for NHTSA and IACP); Officer William Morrison (Montgomery County Police Department Chemical Test Unit Coordinator); Lt. Thomas Woodward (Maryland State Police Barrack Commander in Hagerstown, Maryland); and Dr. Zenon Zuk (M.D. who has been in practice for 30 years).

The defense relied upon three experts: Dr. Francis Gengo (clinical pharmacologist with post-doctoral fellowship in Pharmacokinetics & Pharmacodynamics at the State University of New York); Dr. Neal Adams (ophthalmologist and currently Chair of the Ophthalmology Department at Texas Tech University Medical School); and Dr. Jeffrey Janofsky (Associate Professor of Psychiatry at Johns Hopkins University School of Medicine).

The amount of work necessary to prepare this extremely detailed evidentiary hearing by defense counsel, Alex Cruickshank and Brian DeLeonardo, cannot be overstated. The preparation is evident in the statements elicited from the witnesses during their testimony. For instance, during cross-examination,

Mr. Tower testified that even if no drugs at all are found in the subject's blood, the DRE is 'not going to change [their] opinion after you get the blood.' [citation omitted] **Mr. Tower stated that the reason there would be no change in the officer's opinion is that 'you are limited on what the lab can test for.'** [citation omitted[457]

The court ultimately determined the DRE evidence was inadmissible because the DRE program failed to meet the *Frye*[458] standards. The court rejected decisions from other jurisdictions, which held that *Frye* need not be applied to the DRE protocol because the evidence is not based upon new or novel scientific principles.[459] The court also distinguished *State v. Baity*,[460] where the Washington Supreme Court held that under the *Frye* test the DRE program met the general acceptance standard. The Maryland Circuit Court, in rejecting the *Baity* holding, properly noted that,

[The Washington] court erred in defining the relevant scientific community. NHTSA and the IACP are long-time proponents of the DRE program and have a vested interest in its acceptance and use. 'General scientific recognition may not be established without the testimony of disinterested and experts whose livelihood is not intimately connected with the program.' [citation omitted[461]

The court based its holding upon the following "Findings of Fact":

The DRE Protocol fails to produce an accurate and reliable determination of whether a suspect is impaired by drugs and by what specific drug he is impaired.

The DRE training police officers receive does not enable DREs to accurately observe the signs and symptoms of drug impairment, therefore, police officers are not able to reach accurate and reliable conclusions regarding what drug may be causing impairment.[462]

In 2013, Greg Kane, M.D. examined the original Law Enforcement Drug Assessment adapted by the National Highway Traffic Safety Administration that was originally used to determine the diagnostic accuracy of the DRE protocol. His article, published in a peer-reviewed journal, reports that the three original studies (two directly sponsored by NHTSA and a third funded by the Arizona Department of Transportation) were subject to spectrum bias, selection bias, mis-classification bias, verification bias, differential verification bias, incorporation bias, and review bias.[463] Accordingly, Dr. Kane concluded that these studies do not validate current DRE practice.[464]

[C] Impeaching the Credibility of the Evaluator

Defense counsel should not be misled by the "E" in "DRE." Despite the common use of terms such as expert, technician, and specialist, a DEC trained officer's credentials should not be enhanced based solely upon his or her title.[465] A successful impeachment of the credibility of the DEC evaluator begins with an understanding of the limitations of the DEC program. Accordingly, when encountering an arrest based upon the DEC protocol, special attention should be paid to not only the program itself, but also to the qualifications of the officer and the details of the individual DEC evaluation.

Limitations of the DEC Program

Although the training received by these officers[466] exceeds any basic training to detect those who may be driving while impaired, it is not a substitute for proper scientific or medical training. There certainly is no dispute that certain substances will affect the human body in specific and often identifiable ways; however, what is in dispute is whether a law enforcement officer who has received DEC training is qualified to make such scientific/medical conclusions. It is important to consider the years of education, training, and certifications associated with medical and scientific professionals. One must recognize that there is a wide variability in the manner in which drugs may affect different people and even the way they affect the same person at different times.

Even a close examination of the scientific community involved in developing this protocol reveals significant deficiencies.[467] As recognized in the 2012 case of *State v. Brightful*,[468]
. . . [T]he drug recognition protocol is a new and novel technique because it purports to create a protocol for police officers to render a medical diagnosis. When the relevant scientific community is properly denied to include disinterested medical professionals it is clear that the drug recognition protocol is not generally accepted as reliable. . . . [T]he Court finds that a drug recognition expert is not sufficiently qualified to render an opinion, that the testimony is not relevant, and the probative value of the evidence is substantially outweighed by its prejudicial effect.

Further, officers may be trained to observe certain signs or symptoms, but may not understand how or why a sign or symptom actually manifests. For example, can the officer explain the physiological reasons that cause a CNS stimulant to dilate the pupils or cause hallucinogens to elevate the pulse rate? If the officer is going to testify about medical or quasi-medical examinations, shouldn't the law expect the officer to be properly trained to understand the physiological reasons of the anomalies so that other, non-impairing causes may be noted or excluded? Most jurisdictions require a witness to be qualified as an expert pursuant to the equivalent of Federal Rule of Evidence 702, if the evidence requires "scientific, technical, or other specialized knowledge." Because DEC may be characterized as this type of evidence, a DEC officer should be qualified as an expert before offering testimony about an individual evaluation.[469]

Even more significant is the result of such training. Medical professionals (physicians, nurses, pharmacologists, etc.) exercise their education, training, and judgment in their work each day. Diagnoses are often reviewed by an independent professional who conducts a separate examination (obtaining a second opinion).

Contrast this health professional with a DEC-trained officer who receives less than two weeks (typically 72 hours) of classroom instruction. Of the training time, a mere two hours is spent on generalized physiological instruction of the symptoms associated with particular drug categories.

After the original certification, the officer is required to become recertified every **two years**. During this time, the officer is only required to conduct **four** hands-on evaluations in addition to **eight hours** of in-service training.[470] It is important to note that all of these evaluations may be performed during classroom simulations. It should be further noted that law enforcement officers, rather than medical professionals, administer all DEC training.

Even if the officer must be qualified as an expert pursuant to the rules of evidence, it may not be appropriate to refer to them as experts in court. The Supreme Court of Minnesota has recognized the danger in presenting DEC-trained officers as "experts:"

In general it seems to us misleading for the state to present the officer as a ""Drug Recognition Expert." That appellation suggests that there is something scientific about the officer's testimony, thus requiring the court to determine whether the scientific underpinnings of the testimony are adequately accepted in scientific circles. We are of the opinion, however, that the protocol in question does not demand the kind of scrutiny required for the presentation of some novel scientific discovery or technique. The real issue is not the admissibility of the evidence but the weight it should receive, and that is a matter for the jury to decide without being led to believe that the evidence is entitled to greater weight than it deserves. Therefore, in the courtroom the officer shall not be called a "Drug Recognition Expert." Perhaps the officer can be called a "Drug Recognition Officer" or some other designation which recognizes that the officer has received special training and is possessed of some experience in recognizing the presence of drugs without suggesting unwarranted scientific expertise. After careful consideration we conclude that opinion testimony based on nystagmus testing is admissible if a sufficient foundation has been laid for the opinion expressed and provided that the trial court, when requested, gives an appropriate cautionary instruction.[471]

Interestingly, an implied limitation of the DEC was noted in the NHTSA manuals published prior to 2011. The implied limitation stated that the program, "is not 100% accurate, especially in a climate of polydrug use. However, it will furnish reliable evidence of the link between a particular subject and a particular category of drugs in more than a majority of cases."[472] The statement that the program is reliable in "more than a majority of cases" is a particularly troublingly low accuracy rate considering the fact that a suspect's reputation and freedom rests in large part, on the results of the testing. Furthermore, no testing or even allegation provides that the DEC protocol can provide a reliable correlation to driving impairment, as indicated in the assertion that the protocol *furnishes a link between the subject and a particular drug category*.

In fact, citizens subjected to DEC often may not have exhibited any apparent signs of driving impairment. Consider motorists stopped for speeding, tag or brake light violation, or registration violation. None of these violations can be classified as impaired driving.[473]

Unlike driving under the influence of alcohol, comparatively few studies have been done to identify the correlation of impaired driving by specific drugs.[474] A summary of the testimony of Jeffrey Janofsky, M.D. (Associate Professor of Psychiatry at Johns Hopkins University School of Medicine) in *State v. Brightful*[475] is also instructive:

Dr. Janofsky testified that the matrix is not something accepted in the scientific and medical communities.[476] When asked whether he knew anyone in the medical, psychiatric, scientific, or clinical research fields who accepted the matrix as useful, he replied:

I have got to tell you, your Honor, DRE is something that's not foremost in the minds of those of us who take care of substance abusers, clinically or forensically. People are aware of it. But it's--no one I know of, no physician I know of would even consider using this matrix or the--even pieces of it in determining either whether someone was impaired on drugs or even more ridiculously to tell which specific category. It's ridiculous--I can't emphasize that enough. [citation omitted]

Dr. Janofsky testified that there is a major difference between alcohol and drug interactions in the body. He further testified that the DEC Manual improperly equates the medical definition of impairment with impairment to drive. He testified that the DEC Manual does not address the concept that certain indicators may only show the "presence of the drug and not intoxicating levels causing behavioral impairment." [citation omitted] Dr. Janofsky testified that while there are studies linking alcohol to driving impairment, no studies exist regarding the drugs the DRE lists in its seven categories. Dr. Janofsky also testified that the drugs identified in the seven drug categories are incorrectly lumped together, i.e., the CNS depressant class which includes barbiturates, Benadryl, various benzodiazepines and antidepressant medications that no physician would group together because they have extraordinarily different neurophysiologic actions. [citation omitted] He testified that there are whole classes of drugs listed under CNS depressants that would have the opposite effect on the body than what is listed for that drug category in the matrix.

The DEC training itself further acknowledges that medical conditions or injuries may cause a suspect to appear under the influence of drugs that they have not consumed.[477] The manual specifically lists the following commonly encountered medical conditions: bipolar disorder (manic depression), conjunctivitis, diabetes, head trauma, multiple sclerosis, shock, stroke, carbon monoxide poisoning, seizures, endocrine disorders, neurological conditions, psychiatric conditions, and infections.[478] More significantly, officers are also trained that *normal* conditions such as exercise, excitement, fear, anxiety, and depression may affect vital signs.[479] Of course, even though the DEC training includes the identification of these medical and normal conditions that may be mistaken for drug use, officers do not receive training on diagnosing these medical conditions. Accordingly, absent the intervention of a health care professional, how could an officer effectively rule out medical or physical impairment? Moreover, this list of conditions that may mimic drug impairment is far from complete. In fact, a recent medical study reported that HGN was observed in those who suffer from migraine headaches,[480] a condition that is said to affect as much as 23.6% of the U.S. population.[481] As discussed in § **5.04[D][1], Horizontal Gaze Nystagmus**, the presence of HGN is associated with numerous physiological and other causes independent of drug or alcohol ingestion.

Often, a person undergoing the DEC examination has been involved in a motor vehicle accident. However, notably missing from the protocol is the requirement of the officer to physically check the subject for visible injuries. In fact, the original field validation study sponsored by NHTSA and conducted by researchers from Johns Hopkins University excluded any subject who was involved in a crash "since injuries could have confounded the drug examination."[482] Accordingly, one could argue that the DEC protocol should not be used to evaluate anyone involved in a motor vehicle accident.

The evaluator's recognition of a symptom is important but understanding and interpreting whether it is caused by intoxication is a skill that requires knowledge of the pathophysiology of disorders in the human body. No smart physician would take the word of an officer, an emergency medical technician, or a nurse regarding physical examination findings. Instead, the physician would examine and evaluate the subject himself. Accordingly, one must wonder if society is asking too much of the DEC evaluator.

An additional resource readily available to practitioners is the "Drugs and Human Performance Fact Sheets" report.[483] A panel of international experts on drug-impaired driving met in August 2000 to review drugs and human performance; to identify the specific effects that both illicit and prescription drugs have on driving; and to develop guidance for others when dealing with drug-impaired driving problems. Delegates represented the fields of psychopharmacology, behavioral psychology, drug chemistry, forensic toxicology, medicine, and law enforcement experts trained in the recognition of drug effects on drivers in the field.[484] The Fact Sheets represent the conclusions of the Panel and include the state of current scientific knowledge in the area of drugs and human performance for the 16 commonly used drugs--both over the counter and prescription--selected for evaluation.[485]

Limitations Posed by Officers and the Individual Evaluations

As with the Standardized Field Sobriety Tests, the key to discrediting the opinion of the DEC evaluator is noting the details. This is particularly important because the evaluator is infrequently the arresting officer. Therefore, the DEC officer has only the DEC protocol and his observations upon which to base his opinion.

Much of the information documented by the evaluator is noted on the pre-printed form for the purpose of recording the evaluator's findings. This form, called the "Face Sheet," is much more detailed than that used to note results in Standardized Field Sobriety Testing. An example of a blank form can be found below as well as on our online service, Cheetah, Form 5-1, **Blank DRE Face Sheet**. Another example of a properly completed Face Sheet can also be found below and on our online service, Cheetah, Form 5-2, **Completed DRE Face Sheet**. The information compiled is typically then compared against what is referred to as the DEC "Matrix" to determine what substance is present in the suspect's system. This "Matrix" can be found below and on our online service, Cheetah, Form 5-3, **Drug Category Symptomology Chart**.

When encountering a DEC evaluation, defense counsel should always investigate the officer's qualifications and, at a minimum, review the following relevant documentation and ask the following questions:

• The officer's training materials--was the officer trained under the most recent manual?

• The officer's certification card--what is the expiration date?

• The officer's progress log--did the officer pass every training phase, as approved by an instructor?

• The Rolling Logs ("Rolling Log" is the informal name of the log used to document the drug influence examinations)--compare recent opinions of the officer with the lab test results.

• An updated curriculum vitae of the officer--has he complied with the recertification requirements?

Counsel should also be critical of the individual evaluations and focus not only on what symptoms the officer *identified*, but also what symptoms the officer *failed to identify*. Did the suspect exhibit all of the expected signs or symptoms of the opined drug category? Special attention should also be given to the normal actions exhibited by the suspect (e.g., normal vital signs, no difficulties with normal psychophysical actions, etc.). Of course, determining what is "normal" for an individual suspect also poses a problem because ""normal" is so subjective. For instance, the "normal" ranges established for vital signs such as temperature and pulse are based upon an average range. Naturally, some people, with no drugs in their system, will fall outside of what is determined to be the average range. It is impossible for an officer in the field to know a suspect's normal vital signs.

The officer's evaluation should be examined to determine if the 12 steps were performed as required by the training manual.[486] Because of the limitations of the DEC training, the officer's conclusions may be characterized as an educated guess, rather than a logically established conclusion. As such, it becomes increasingly important for the officer to strictly follow the protocol. Any deviations will result in a less reliable conclusion and could identify a false positive or false negative. Unfortunately, unlike a situation in which a doctor diagnoses an illness, a criminal suspect is not given the benefit of obtaining a second opinion. As detailed below, each of the 12 steps of the Drug Evaluation and Classification protocol should be closely examined.

Step 1: Breath Alcohol Test

If a suspect refuses to submit to a breath alcohol test, the officer will not be able to determine if the observed impairment is caused in whole or in part by alcohol consumption. Additional problems may exist when the breath test is improperly administered (e.g., proper observation period is not observed).

Step 2: Interview of the Arresting Officer

Examine closely the DEC-trained officer's interview of the arresting officer. It is important for the DEC officer to ask specific, pointed questions rather than asking for an open-ended assessment from the arresting officer, such as ""What do we have here?"[487] Lack of thorough interview increases the risk of substituting the more unreliable conclusion of a nontrained DEC officer.

Step 3: Preliminary Examination

Did the DEC officer perform a thorough preliminary examination before proceeding with more intensive testing or did he rush through the examination, asking only a handful of questions? This is the step where the officer determines whether the subject is medically qualified to continue the DEC evaluation. Keep in mind the fact that the suspect was likely not informed that the tests were voluntary or that he could choose to stop testing anytime.

Step 4: Examination of the Eyes

The eye examinations, Horizontal Gaze Nystagmus (HGN), Vertical Gaze Nystagmus (VGN), and Lack of Convergence, represent the first quasi-medical tests administered by the DEC officer and must be carefully administered. For instance, an officer can unintentionally manipulate the results of the HGN test by improper administration (e.g., holding the stimulus too high or too low). All three tests given at this stage may be caused by medical or other conditions independent of intoxicant ingestion. As discussed above, horizontal gaze nystagmus in particular may be observed in persons who are not necessarily under the influence of an intoxicant. Lack of convergence may also be a congenital condition or may be exhibited in those suffering from attention deficit disorder, a head injury, or something as innocuous as eyestrain (e.g., from prolonged reading of a computer monitor or text books). Moreover, convergence insufficiency (lack of convergence) has been noted in over 60% of persons over the age of 60.[488]

In the *Brightful* opinion, the court referred to the testimony of defense ophthalmologist, Dr. Adams.
Dr. Adams testified that in the Shinar Study, DREs found HGN in the categories where a drug could not even cause HGN and in his expert opinion that demonstrates, “that you really need 2 things to interpret nystagmus. You need a properly performed test and you need to understand nystagmus and be able to ask these other 11 questions[489] to be able to determine where that nystagmus came from.” He further testified that none of the questions that must be asked in order to properly diagnose nystagmus, however, are asked by the DRE. He testified that there are many medical conditions that can cause HGN including that “the data has spoken for itself that [the DRE protocol] cannot reliably discern impairment from non-impairment and cannot reliably identify the medication allegedly causing the impairment.”[490]

Step 5: Divided Attention Psychophysical Tests

Field sobriety testing was originally developed to estimate BLAC. No link has been established between a suspect's performance on the psychophysical tests (Romberg Balance, Walk-and-Turn, One-Leg-Stand, and Finger-to-Nose) and the consumption of drugs. Of course, one must wonder about the genesis of the correlation between the Romberg Balance test and the Finger-to-Nose test, both of which were deemed too unreliable to include in the battery of tests to estimate BLAC. Without testing that correlates these psychophysical tests with drug impairment, it can easily be argued that these tests fail to meet the evidentiary rule of relevance.

It is also important to examine whether the officer properly and medically qualified the suspect for the psychophysical tests. Was the suspect asked if he had any physical or medical problems that would hinder him from walking heel to toe or standing on one leg? Did the officer ask if the suspect had any conditions that would cause him to sway with his head back and eyes closed?

Step 6: Vital Signs Examinations

A blood pressure examination is not as simple as it may seem. In fact, this procedure is laden with the potential for errors and inaccurate results due to the equipment, examiner, or examinee. Although the following discussion focuses on blood pressure measurement, similar issues may arise when measuring a suspect's temperature and pulse rate.

Interestingly, the *Brightful* court again relied upon Dr. Janofsky. ". . . Vital signs are not something the medical community uses to show drug impairment and he knows of no one in the medical field that does use vital signs as an indicator."[491]

Although the Drug Recognition and Classification program teaches that high and low blood pressure readings may indicate the presence of certain drugs, a large portion of our society is inflicted with high (hypertension) or low (hypotension) blood pressure. In fact, according to the Center for Disease Control, one in three adults in the United States suffer from high blood pressure (hypertension).[492] Many people are not aware that they suffer from high blood pressure. The disease of hypertension is often referred to as ""the silent killer." Like any of the vital signs, the officer does not know the normal blood pressure reading for the suspect. Accordingly, an officer should question the suspect to determine if other factors may contribute to the blood pressure result, such as the suspect's weight, normal conditioning, kidney function, atherosclerosis (hardening of the arteries), smoking habits, food consumption, oral contraceptives, etc.[493]

Similarly, when the evaluator takes the subject's blood pressure, there are no provisions taken into account for "white coat syndrome," or in this case, "blue uniform syndrome." "White coat syndrome" is a medically recognized mechanism, which occurs at a subconscious level causing the patient's blood pressure to elevate only when taken at the doctor's office due to the apprehension experienced by the patient.[494]

Furthermore, what if the blood pressure reading is just slightly out of the range of "normal?" Does a measurement of 2 mm of mercury high or low mean the subject is exhibiting an abnormal blood pressure due to the presence of a particular drug? A minimal variation from "normal" is considered to be either elevated or depressed in a DEC evaluation.

It is imperative for defense counsel not only to discover whether the equipment was in proper working order and correctly calibrated, but also to ensure that the proper equipment was used. For instance, many people do not realize that a blood pressure cuff is not "one size fits all." In fact, an incorrect cuff size could lead to a false result--a cuff that is too large may result in a falsely low blood pressure reading, while a cuff that is too small will falsely inflate a blood pressure reading.[495] The evaluating officer's technique should also be closely examined, as there are 12 detailed steps necessary for an accurate blood pressure measurement:[496]

1. Select an appropriately sized cuff.

2. Palpate for the brachial artery along the inner upper arm.

3. Wrap the cuff smoothly and snugly, centering bladder over the brachial artery. Do not rely on cuff markings. Tell the patient not to talk.

4. Determine the level of maximum inflation by rapidly inflating cuff while watching for point where you can no longer feel radial pulse and add 30 mm Hg.

5. Deflate the cuff rapidly and steadily, then wait for 15 to 30 seconds before re-inflating.

6. Insert the stethoscope earpieces, making sure they point forward. Apply the bell head lightly but with complete contact over the palpable brachial artery.

7. Inflate the cuff rapidly and steadily to the level of maximum inflation (see step 4).

8. Release air so the pressure falls at 2-3 mm Hg per second.

9. Listen for onset of at least two consecutive beats--systolic pressure. Note the closest mark on the manometer. Always record blood pressure measurement in even numbers.

10. Listen for cessation of sound with adults--diastolic pressure. Continue listening for 10-20 mm Hg below last sound to confirm reading, then deflate the cuff rapidly and completely.

11. Record the patient's blood pressure, position (sitting or standing), cuff size, and arm used.

12. Wait 1-2 minutes, then repeat the same procedure on the same arm so that blood trapped in arm veins can be released. If the initial reading is elevated, take two additional measurements at 1-2 minute intervals.

In addition to the inherent errors that may occur when an individual with no medical training performs a vital signs examination, the DEC training also indicates "normal" ranges for pulse and blood pressure that differ from those accepted in the medical community. For instance, the DRE Matrix specified a normal blood pressure range of 120-140 Systolic and 70-90 Diastolic. The medical community, however, indicates a normal blood pressure for those with a Systolic *below* 120 and a Diastolic *below* 80.[497] Accordingly, a blood pressure that may be considered normal in the medical community (e.g., 115/68) would be categorized as low by the DEC curriculum.

Step 7: Dark Room Examinations

Like the other quasi-medical examinations, the dark room examination procedure must be followed as closely as possible to the DEC guidelines in order to obtain the objective information necessary to form a valid opinion. The first estimate should be made under room light, while the final two estimations are done in near total darkness. Some of the issues, which may bring into question the validity of the pupil size and reaction data obtained by the examiner include:
1. the accurate comparison of the subject's pupil size with the standard (pupilometer card);

2. the varying room lighting for each examining room, including the level of brightness, different placement of lights, and different types of light--direct and indirect; and

3. the level of "total darkness" and timing of measurements. The room must be absolutely dark except for the extremely minimal light emanating from the officer's penlight. A good evaluator should place a towel, jacket, or other object under the door to prevent any ambient light from entering the room and affecting the results. Furthermore, no measurement should be taken for at least 90 seconds after the room becomes dark.

Further, during the direct light examination for each eye, the evaluator must, within 15 seconds:
a. Determine whether the subject's eyes have a normal or slow reaction to light;

b. Estimate the proper pupil size; and

c. Observe the eyes for rebound dilation.[498]

It is important to highlight that four out of seven drug categories indicate a *normal* pupil size.

Sometimes mistakes in the Matrix are recognized, but slow to be corrected. For instance, the NHTSA training, prior to 2010, required officers to check for hippus. (a rhythmic pulsating of the pupils as they dilate and constrict within fixed limits) as an indicator of a narcotic analgesic. Perhaps because of the numerous alternative causes of hippus, such as multiple sclerosis, cerebral disease, meningitis, syphilis, and chorea, this indicator has since been eliminated from the curriculum. One may also assume this was done as a result of the false positives occurring when hippus was noted in the subjects. However, one cannot help but wonder how many were falsely arrested due to this misinformation?

Step 8: Examination of Muscle Tone

Determination of whether the suspect's muscle tone is rigid or flaccid is a subjective standard. For instance, when examining a suspect who regularly lifts weights to build muscle tone, such a suspect may always exhibit rigid muscle tone. It would also be difficult to measure muscle tone in persons who have excess skin or are obese.

Step 9: Examination for Injection Sites

Did the officer properly examine the alleged injection sites? The officer should also be able to explain whether the sites are fresh, old, etc.

Step 10: Suspect's Statements and Other Observations

Were such statements gained in violation of the suspect's right to remain silent?

Step 11: Opinion of the Evaluator

Ultimately, the evaluator must use the findings of the subject's examination and compare it to the DEC Matrix[499] in order to determine which, if any, drugs may be present. One should not assume, though, that a particular evaluator is proficient in reaching a correct conclusion. It is essential that defense counsel research the evaluator's history to verify the prior accuracy of the evaluator. This may be accomplished by issuing a subpoena or submitting a Freedom of Information Act request for the officer's rolling log and comparing the officer's opinions with the corresponding toxicological examinations. It is important to know whether the evaluator has the ability to update or make changes to the rolling log once the toxicological results are concluded.

Step 12: Toxicological Examination

While the DEC officer may or may not be the person collecting biological specimen the chemical test or tests, dependent upon the jurisdiction, defense counsel should investigate to be certain the proper chain of custody was maintained and procedures were followed to maintain the integrity of the sample. Counsel should also become familiar with the analytical method, gas chromatography, used to identify the intoxicant(s) in question to be certain the result is accurate.

Even if the defense practitioner is unable to discredit the factual findings of the evaluator, there remains an opportunity to argue that the fact lacks any legal significance. For instance, in *State v. Hechtle*,[500] the Utah Court of Appeals found probable cause to arrest did not exist when the arresting trooper arrested Mr. Hechtle for driving with a measurable controlled substance or metabolite of a controlled substance in the person's body.[501]

The officer, who was not a DRE, but had attended DRE classes and had received some drug interdiction training, arrested the defendant based on the officer's finding that the defendant had multiple air fresheners in his vehicle, the occupants' lit cigarettes upon the officer's approach, the defendant was extremely helpful, the defendant's eyes were red and glassy, droopy, and dilated. Moreover, when the trooper asked Mr. Hechtle to stick out his tongue, the trooper noted the suspect's tongue was “very green” with “blisters all over the back of it.” This information “confirmed” to the trooper that Hechtle had been smoking marijuana.[502]

The court concluded that while the facts were suggestive of possible drug use, there were no facts to indicate the defendant had a measurable amount of controlled substance in his body.[503] The court was troubled by the officer's failure to detect any drug paraphernalia, any sign of recent drug use, or odor of marijuana emanating from either the car or suspect.[504]

The officer's failure to conduct field sobriety tests, or to involve a certified DRE confirm his suspicion left the record devoid of facts indicating how long measurable quantities of marijuana remain in the system. Accordingly, the court held that the mere suspicion that Mr. Hechtle had, at some point in the past, ingested marijuana was insufficient to establish probable cause to arrest.[505]

Footnotes

411 Most of the citations throughout this chapter reference the DRE Participant Manual. The practitioner should be aware that NHTSA released updated DRE Manuals in February 2018, copies of which can be accessed by visiting: https://www.wsp.wa.gov/breathtest/dredocs.php (last visited Feb. 10, 2021).

412 Drug Evaluation and Classification Pre-School Student Manual (HS 172A R1/07) at I-3.

413 *See* Drug Recognition Expert Course Participant Manual, Preface, p. 1 (Revised: 10/2015)

414 *See* http://www.ntis.org.

415 The information in this section is taken substantially from the Drug Recognition Expert Course Participant Manual, Session 3, pp. 2-5 (Revised: 02/2018).

416 Drug Recognition Expert Course Participant Manual, Session 3, p. 4 (Revised: 02/2018).

417 Drug Recognition Expert Course Participant Manual, Session 3, p. 9 (Revised: 02/2018).

418 Drug Recognition Expert Course Participant Manual, Session 3, p. 14 (Revised: 02/2018).

419 Drug Recognition Expert Course Participant Manual, Session 3, p. 15 (Revised: 02/2018).

420 Drug Recognition Expert Course Participant Manual, Session 3, p. 12 (Revised: 02/2018).

421 Drug Recognition Expert Course Participant Manual, Session 3, p. 12 (Revised: 02/2018).

422 Drug Recognition Expert Course Participant Manual, Session 3, p. 13 (Revised: 02/2018).

423 [Drug Recognition Expert Course Participant Manual, Session 3, p. 14 (Revised: 02/2018).]

424 *See* https://www.theiacp.org/projects/the-international-drug-evaluation-classification-program (last visited Feb. 10, 2021).

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426 Drug Recognition Expert Course Participant Manual, Session 3, p. 7 (Revised: 02/2018).

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430 Eugene V. Adler & Marcelline Burns, *Drug Recognition Expert (DRE) Validation Study*, Final Report to Governor's Office of Highway Safety, State of Arizona (June 4, 1994), Table 5.

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432 The information in this section is taken substantially from the Drug Recognition Expert Course Participant Manual, Session 4, p. 3 (Revised: 02/2018).

433 State v. Baity, 140 Wash. 2d 1, 4-5, 991 P.2d 1151, 1154 (Wash. 2000).

434 State v. Baity, 140 Wash. 2d 1, 4-5, 991 P.2d 1151, 1155 (Wash. 2000).

435 Drug Recognition Expert Course Participant Manual, Session 4, p. 49 (Revised: 02/2018)

436 Drug Evaluation and Classification 7-Day School Student Manual (HS 172 R5/13) at IV-4. *See* State v. Cammack, No. C5-96-1000, 1997 WL 104913 (Minn. Ct. App. Mar. 11, 1997) (DRE need not complete entire 12-step evaluation for opinion to be admissible so long as there is sufficient admissible evidence which supports the DRE's opinion.)

437 Drug Recognition Expert Course Participant Manual, Session 4, p. 3 (Revised: 10/2015).

438 State v. Tucker, 139 Wash. App. 1022, at 4 (Wash. Ct. App. 2007).

439 State v. Cammack, No. C5-96-1000, 1997 WL 104913 (Minn. Ct. App. Mar. 11, 1997).

440 State v. Klawitter, 518 N.W.2d 577 (Minn. 1994).

441 State v. Klawitter, 518 N.W.2d 577, 586 (Minn. 1994).

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449 Jeffrey R. Brubacher, et al., *Cannabis Use as a Risk Factor for Causing Motor Vehicle Crashes: A Prospective Study*, 114(9) Addiction, at 1616 (Sept. 2019).

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451 Douglas J. Beirness, Jacques LeCavalier, & Deanna Singhal, *Evaluation of the Drug Evaluation and Classification Program: A Critical Review of the Evidence*, 8(4) Traffic Inj. Pre. 368-76 (Dec. 2007).

452 Douglas J. Beirness, Jacques LeCavalier, & Deanna Singhal, *Evaluation of the Drug Evaluation and Classification Program: A Critical Review of the Evidence*, 8(4) Traffic Inj. Pre. 368-76 (Dec. 2007).

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455 Amy J. Porath-Waller and Douglas J. Beirness, *An Examination of the Validity of the Standardized Field Sobriety Test in Detecting Drug Impairment Using Data from the Drug Evaluation and Classification Program*, Traffic Injury Prevention, Taylor & Francis Group, 125-31 (Apr. 25, 2013).

456 Maryland v. Brightful, et al., No. K-10-04-259 (Md. Cir. Ct. Carroll Co. Mar. 5, 2012). Because of the difficulty in obtaining a copy of this important decision, an electronic copy of the *State v. Brightful* decision is now available on our online service, Cheetah. To enquire about access, please contact your sales representative or visit our website at lrus.wolterskluwer.com.

457 Maryland v. Brightful, et al., No. K-10-04-259, at *9 (Md. Cir. Ct. Carroll Co. Mar. 5, 2012) (emphasis in original).

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459 Maryland v. Brightful, et al., No. K-10-04-259. at *23-*25 (Md. Cir. Ct. Carroll Co. Mar. 5, 2012) (citing State v. Klawitter, 518 N.W.2d 577 (Minn. 1994); Williams v. State, 710 So. 2d 24 (Fla. Dist. Ct. App. 1998); and State v. Layman, 953 P.2d 782 (Utah Ct. App. 1998)).

460 State v. Baity, 991 P.2d 1151 (Wash. 2000).

461 Maryland v. Brightful, et al., No. K-10-04-259 at 28 (Md. Cir. Ct. Carroll Co. Mar. 5, 2012).

462 Maryland v. Brightful, et al., No. K-10-04-259 at 36 (Md. Cir. Ct. Carroll Co. Mar. 5, 2012).

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464 DRE Peer Review, Greg Kane, *The Methodological Quality of Three Foundational Law Enforcement Drug Influence Evaluation Validation Studies*, J. Negative Results Biomedicine 12:16 (2013).

465 A substantial portion of this subsection has been reproduced or derived from the paper titled *Don't Be Misled By the "E" in DRE: A Defense Perspective on the DEC Protocol*, by Steven Oberman and Sara Compher-Rice (©2011), with the express permission of the authors.

466 DEC training includes 72 hours of classroom instruction, followed by field certification (total hours vary based upon jurisdiction), and is completed with an 8-hour certification examination.

467 *See* Douglas Beirness, Jacques LeCavalier, & Deanna Singhal, *Evaluation of the Drug Evaluation and Classification Program: A Critical Review of the Evidence*, Traffic Injury Prevention, 8:4, 368-76 (Dec. 2007) (laboratory studies do not provide overwhelming support for accuracy of DEC officers).

468 State v. Brightful, Memorandum Opinion and Order, K-10-40259, p. 34 (Carroll Co., Md. Cir. Ct. Mar. 5, 2012). A copy of the *Brightful* decision is now available on our online service, Cheetah. To enquire about access, please contact your sales representative or visit our website at lrus.wolterskluwer.com.

469 *See*, *e.g.*, State v. Murphy, 953 S.W.2d 200 (Tenn. 1997) (holding HGN results testimony requires witness to be qualified as an expert).

470 *The International Standards of the Drug Evaluation and Classification Program*, The DEC Standards Revision Subcommittee of the Technical Advisory Panel of the IACP Highway Safety Committee at 19 (Jan. 21, 2007).

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472 Drug Recognition Expert Course Student Manual, Session III, p. 7 (Revised: 01/2010).

473 *See also* § 5.02, **Driving Symptoms**.

474 *See also* § 1.06, **Under the Influence of Drugs**.

475 State v. Brightful, Memorandum Opinion and Order, K-10-40259, p. 19 (Carroll Co., Md. Cir. Ct. Mar. 5, 2012).

476 *See also* State v. Brightful, Memorandum Opinion and Order, K-10-40259, pp. 13-14 (Carroll Co., Md. Cir. Ct. Mar. 5, 2012) (defense pharmacology expert Dr. Francis Gengo testified that the drugs referenced in the matrix are misclassified and that some of the drugs have a completely different effect on the body than what is predicted in the matrix).

477 Drug Recognition Expert Course Participant Manual, Session 6, p. 46 (Revised: 02/2018).

478 Drug Recognition Expert Course Participant Manual, Session 6, pp. 47-48 (Revised: 02/2018).

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482 Drug Recognition Expert Course Participant Manual, Session 3, p. 14 (Revised: 02/2018).

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484 Fiona J. Couper & Barry K. Logan, *Drugs and Human Performance Fact Sheets*, DOT HS-809 725, at 3-4 (Revised Apr. 2014). This document is available for download online at https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/809725-drugshumanperformfs.pdf (last visited Feb. 10, 2021).

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486 *See generally* Drug Recognition Expert Course Participant Manual (Revised: 02/2018).

487 Drug Recognition Expert Course Participant Manual, Session 4, pp. 15-16 (Revised: 10/2015).

488 *See also* Holger Rambold, et al., *Age-related Changes of Vergence Under Natural Viewing Conditions*, Neurobiology of Aging, pp. 163-72 (Jan. 2006), *available at* http://www.ncbi.nlm.nih.gov/pubmed/16243410 (last visited Feb. 10,

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489 *See* State v. Brightful, Memorandum Opinion and Order, K-10-40259, pp. 15-16 (Carroll Co., Md. Cir. Ct. Mar. 5, 2012) (outlining 11 questions an examiner must ask before properly diagnosing the presence of nystagmus).

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491 State v. Brightful, Memorandum Opinion and Order, K-10-40259, p. 30 (Carroll Co., Md. Cir. Ct. Mar. 5, 2012).

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493 George L. Bakris, MD, *High Blood Pressure*, The Merck Manuals (Last Modified Oct. 2019), *available at* http://www.merckmanuals.com/home/sec03/ch022/ch022a.html (last visited Feb. 10, 2021).

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497 *See* http://www.mayoclinic.com/health/blood-pressure/HI00043 (last visited Feb. 10, 2021).

498 Drug Recognition Expert Course Participant Manual, Session 5, p. 6 (Revised: 02/2018).

499 *See* Form 5-3, **Drug Category Symptomology Chart**, is now available on our online service, Cheetah. To enquire about access, please contact your sales representative or visit our website at lrus.wolterskluwer.com.

500 State v. Hechtle, 89 P.3d 185 (Utah Ct. App. 2004).

501 State v. Hechtle, 89 P.3d 185, 189 (Utah Ct. App. 2004).

502 State v. Hechtle, 89 P.3d 185, 187 (Utah Ct. App. 2004).

503 State v. Hechtle, 89 P.3d 185, 191 (Utah Ct. App. 2004); *see also* People v. McPeak, 927 N.E.2d 312 (Ill. App. Ct. 2010) (holding odor of cannabis and admission to taking hits from a pipe insufficient to convict without further evidence of cannabis in defendant's blood, breath, or urine); People v. Foltz, 934 N.E.2d 719 (Ill. App. Ct. 2010).

504 State v. Hechtle, 89 P.3d 185, 191 (Utah Ct. App. 2004).

505 State v. Hechtle, 89 P.3d 185, 191 (Utah Ct. App. 2004).

EXHIBIT J

U.S. Department
of Transportation
National Highway
Traffic Safety
Administration

People Saving People
http://www.nhtsa.dot.gov

DOT HS-802 424

PSYCHOPHYSICAL TESTS FOR DWI ARREST

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June 1977
Final Report

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16. Abstract As part of DWI arrest procedures, tests of alcohol impairment may be used by police officers, either at roadside or in the station. Objectives of this study included evaluation of currently-used tests, development of more sensitive and reliable measures, and the standardization of test administration.

On the basis of preliminary investigations, six tests were chosen for an evaluation study. Ten officers administered the 6-test battery to 238 participants who were light, moderate and heavy drinkers. Placebo or alcohol treatments produced BACs in the range 0 - .15%. The police officers scored the performance of each test on a 1-10 scale, and on the basis of the entire battery judged whether the person should be arrested or released.

All of the 6 tests were found to be alcohol sensitive, and the officers made correct arrest/release decisions for 76% of the participants. Data analysis led to recommendations of a "best" reduced battery of tests which includes examination of balance (One-Leg Stand) and walking (Walk-and-Turn), as well as the jerking nystagmus movement of the eyes (Alcohol Gaze Nystagmus).

17. Key Words alcohol DWI arrests test of impairment		18. Distribution Statement Document is available to the public through the National Technical Information Service, Springfield, VA 22161	
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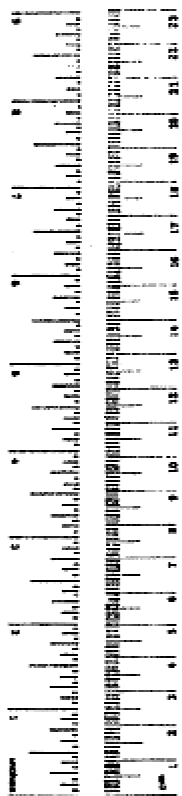
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

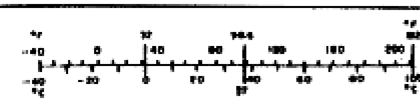
Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

TECHNICAL SUMMARY	
CONTRACTOR SOUTHERN CALIFORNIA RESEARCH INSTITUTE	CONTRACT NUMBER DOT-HS-5-01242
REPORT TITLE "Psychophysical Tests for DWI Arrest"	REPORT DATE January 1977
REPORT AUTHOR(S) Marcelline Burns, Ph.D. and Herbert Moskowitz, Ph.D.	

The objectives of "Psychophysical Tests for DWI Arrest" were:

(1) To evaluate currently used physical coordination tests to determine their relationship to intoxication and driving impairment,

(2) To develop more sensitive tests that would provide more reliable evidence of impairment, and

(3) To standardize the tests and observation.

Criteria for the selection of sobriety tests and an initial list of potential tests were derived from field observations, interviews with law enforcement officers and from a literature review. Administration and scoring procedures were standardized during laboratory pilot studies of the tests. On the basis of these preliminary investigations the following tests were chosen for an evaluation study: One-Leg Stand, Walk-and-Turn, Finger-to-Nose, Finger Count, Alcohol Gaze Nystagmus (AGN), Tracing, and alternate tests (Romberg body sway, Subtraction, Counting Backward, Letter Cancellation).

For the evaluation study ten officers (police, sheriff, and highway patrol) served as examiners, administering the tests of impairment to 238 participants who were Light, Moderate and Heavy drinkers. Placebo or alcohol treatments produced BAC's in the range 0-.15%. The officer scored an individual's performance of each test on a 1-10 scale, and after administering the entire battery recorded his decision as to whether the individual should be arrested or released if the testing were occurring at roadside, assuming a legal criterion of .10% BAC.

All of the tests were found to be alcohol sensitive. The arrest/release decisions were correct for 76% of the participants, but the officers' scoring indicated that they had adopted a lower level of impairment as a decision criterion for arrest than would typically be applied in the field. This resulted in a high rate of false-arrest decisions.

(Continue on additional pages)

"PREPARED FOR THE DEPARTMENT OF TRANSPORTATION, NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION UNDER CONTRACT NO.: DOT-HS-5-01242. THE OPINIONS, FINDINGS, AND CONCLUSIONS EXPRESSED IN THIS PUBLICATION ARE THOSE OF THE AUTHORS AND NOT NECESSARILY THOSE OF THE NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION."

HS Form 321
July 1974

A second approach to an arrest/release classification of participants used a test-score criterion as determined by linear regression calculations. On the basis of this analysis a total score greater than the criterion of 28 caused the individual to be classified as at or above .10% BAC and thus subject to arrest. Eighty-three percent of the classifications were correct, and neither false arrest nor false release decisions were unduly high.

A reduced "best" test set was determined by stepwise discriminant analysis. It includes One-Leg Stand, Walk-and-Turn, and Alcohol Gaze Nystagmus. This final, recommended sobriety test battery can be administered without special equipment in most roadside environments, and it can be adapted to yield more precise measurement if administered in the station. The total test time in most cases will be no more than five minutes. More than 83% of the evaluation study participants can be correctly classified on the basis of just these three tests.

If balance and walking skills are examined, and the eyes are checked for the jerking nystagmus movement, the officer will have as much information about intoxication level as can be obtained at roadside. Alcohol gaze nystagmus is a particularly valuable measure, which is underutilized in law enforcement and which merits additional study and application.

The evaluation study data show that substantial impairment typically occurs at a BAC lower than .10%, the current arbitrarily defined level for DWI arrest. It is suggested that a more appropriate legal BAC limit would be .08%.

I. INTRODUCTION

Nationwide traffic accident statistics show a high proportion of alcohol-related fatalities and injury accidents, reflecting the magnitude of the drinking-driver problem. Currently, the principal approach to the problem is deterrence by legal action, and the officer in the field is the first link in the chain of events aimed at the arrest and conviction of a drinking driver. Successful performance by the police officer of the detection and apprehension task, quite apart from any subsequent action directed toward the individual, also results in the immediate removal of an alcohol-impaired driver from the highway.

Data presented by Beitel, Sharp and Glauz (1975) reveal substantial deficiencies in the detection and arrest of DWIs, that is, drivers whose blood alcohol content (BAC) is at or above. 10%. They derived the distribution of drivers' BAC (from roadside survey findings) and also the BAC distribution of drivers arrested for DWI (from arrest records). Figure 1 graphs the two distributions.

As can be observed in the figure, a driver's BAC is almost three times as likely to be in the range. 10-.14% as to be .15-.19%. Yet the smaller number of drivers in the latter, high BAC group are much more likely to be arrested. The probability is .26 that an arrested driver's BAC is .10 to .14%, compared to a .43 probability that it is .15 to .19%.

The discrepancy between the two distributions reflects two major problem areas. First, the officer must detect the drinking driver by observing the vehicle and noting driving errors which may be subtle and ambiguous. The experienced drinker-driver may exceed the .10% level without obvious symptoms of impairment and with very obvious and observable impaired driving behavior occurring only at a quite high BAC. Understandably, the high BAC driver is most frequently spotted by police officers.

The second major problem centers on the arrest/don't arrest decision which must be made once a vehicle has been stopped. Roadside evaluation of a driver's alcohol-related impairment typically is performed under less than optimal conditions. Time is severely constrained; the individual must be arrested or released within a few minutes. The environmental conditions (lighting, noise, space, terrain) vary widely, and test procedures, which are part of the officer's assessment process, must be adapted accordingly. Individual differences in impairment at a given BAC are a function of such variables as drinking history, age, physical condition, illness, disability and fatigue. Also, intoxication may be confused with a variety of other causes of impaired behavior.

As a rule, a police officer is reluctant to arrest a driver unless there is a high degree of certainty that the mandatory chemical test (breath, blood or urine) will yield a BAC reading of .10% or higher. Not only is it costly in officer time and effort to transport and test a driver who cannot be booked, it also leads to charges of harassment and generates bad community relations. These considerations certainly contribute to an over-representation among arrested drivers of those individuals whose BAC is quite high and for whom there is less uncertainty regarding impairment.

As an adjunct to observation and interrogation, the police officer in the field frequently uses behavioral tests to assist in the arrest/don't arrest decision process. Widely-used tests examine balance, coordination and speech, but the exact tests and procedures vary between locales, agencies and officers with no well-defined standards for performance or interpretation. This study was undertaken to develop an improved test battery which will facilitate the officer's identification of alcohol-impaired drivers and provide the required evidence for court proceedings.

II. EVALUATION STUDY

A. Test Selection

A search of the literature was undertaken to locate potentially suitable tests (Appendix 1). Also, observations were made of currently-used tests by riding with city and state police officers and sheriff's deputies in several locations (Appendix 2). The opportunities to observe the field conditions were of great value in developing criteria by which to evaluate potential tests. For example, it became apparent that it is not feasible to include tests which burden the officer with equipment, or which require his prolonged, concentrated attention. The officer must be alert to potential dangers and frequently this means surveillance of a strange environment and hostile bystanders. Realistically, he cannot be preoccupied with test devices nor be involved in any way that impedes access to weapons.

The most common practice is to test a DWI suspect at roadside, but it also is possible to delay all tests until the person has been transported to the station. There is considerable advantage to always giving tests in the same environment. Further, whatever test apparatus is useful can be made available in the station without risk or difficulty for the officer.

It is clear that tests which add a substantial amount of time to DWI procedures will not find wide acceptance. Drunk drivers are costly; the are time-consuming when the arrest is made and again when the officer is required to appear in court. At the same time, effective utilization of police manpower is an ongoing concern. At all levels, including the patrol unit, the officers are charged with achieving maximum law enforcement. From this perspective, a daily log with several DWI arrests may not "look good" in total number of contacts and arrests, so it is scarcely surprising that drunk-driver arrests sometimes are actively discouraged.

The test criteria which appear in Appendix 3 were developed to insure that the battery can be used in the field (or in the station), that the tests will be acceptable to the officers, and that they will provide evidence of impairment. The tests which are described below appeared to meet the criteria and were selected for a preliminary battery.

Alcohol Gaze Nystagmus (AGN)
The jerking movement of the eye, which is known as Alcohol Gaze Nystagmus, occurs upon lateral gaze when BAC exceeds a critical level (≈.06%). The eye jerks in the direction of gaze, independent of head position.
Person is asked to cover one eye and follow movement of a small light or object with other eye without changing head position. Light is moved slowly to points requiring 30° and 40° lateral deviation of the gaze. Test is then repeated with the other eye. Eye is observed for jerking movement.

Walk and Turn, Heel-Toe

Person is instructed to walk straight line, touching heel to toe each step for nine steps, then turn and return along same line in the same manner. Demonstration is given.

Romberg (Balance)

Person is instructed to stand with feet together, head tipped back, eyes closed, arms at side. Position is demonstrated. Observe anterior-posterior sway, 45 sec. trial.

Finger-to-Nose

Person stands erect with eyes closed, arms extended horizontally. Instructions are to touch nose with index finger, alternating right and left hands as instructed. Demonstration is given.

One-Leg Stand

Person is instructed to stand with one leg held straight, slightly elevated off floor, forward, for 30 sec. trial. Eyes remain open.

Finger Count

Person is instructed to touch and count each finger in succession, counting aloud. Demonstrate, "Watch what I do. 1-2-3-4-5-5-4-3-2-1."

Tongue Twisters

Person is asked to repeat such words as "methodist, episcopal, sophisticated statistics."

Subtraction, Addition, Count Backwards

Person is instructed to subtract 3, beginning for example at 102, continuing to some specified number (or add continuously). Same general instructions are given for counting backwards.

Tapping Rate

Person is instructed to tap a telegraph key as rapidly as possible. Number of taps are recorded by electronic counter during 10 sec. trial.

Letter Cancellation

Person is asked to cancel all of a given letter in a paragraph of text during 30 sec. trial.

Tracing

Person is asked to trace paper pathway (maze). Three 20 sec. trials are given.

Grip Strength

Person is instructed to squeeze as hard as possible a dynamometer of the type shaped like a pistol grip with grooves for each finger. This instrument measures force exerted in isometric contraction.

Coin Pick-Up

Three coins (or chips, matches) are placed on floor. Person is instructed to stand in one location and to pick up the coins one at a time, handing them to the examiner. Demonstration is given.

Two-Point Tactile Discrimination

Person is given 2-point tactile stimulation (forearm or back of hand, eyes closed) beginning with no separation of the two points, and is asked "How many places am I touching your arm?" Trials are repeated with increasing separation. Response measure is the first separation to which person responds "two."

Color Naming (Attention Diagnostic Method, modified)

Card presents number 10-59, in random order, in 4 colors by row. Person is instructed to find sequence of 10 numbers, beginning with some designated number, and to report the color of each. Verbal response, for example, might be, "Ten-blue, eleven-white, twelve-yellow, thirteen-red, etc. . ." Response measure is the time to report the colors of ten numbers.

Serial Performance

The device for this test consists of a small box. Five toggle switches and a small bulb are mounted on the face of the box. The box is presented to the subject with all switches in the center position. Subject is told to move the switches and that when they are in the correct sequence of up-down positions, the red light will come on.

B. Pilot Studies

Tests of 19 participants at BACs 0-.10% identified certain tests from the original list as being unsuited to the conditions typically applying to alcohol impairment testing. Grip strength and two-point tactile discrimination show great variability between individuals and cannot be interpreted in the single case without baseline data. The attention diagnostic method (color naming) requires precise instruction and a standard test environment. The serial performance scores did not justify the cost and inconvenience of the apparatus.

After the first pilot study the following tests remained as candidates for the battery: Romberg (body sway), Finger-to-Nose, Alcohol Gaze Nystagmus, Tongue Twisters, Walk and Turn, Finger Count, One-Leg Stand, Subtraction, Tracing (paper maze), Letter Cancellation, and Tapping. The latter three tests would be difficult to use at roadside but were considered to have potential merit for van or station settings.

Thirty participants were examined with these tests, ten each at 0, .10%, and .15% BAC groups.

In addition to the calculation of mean scores for these groups, which appear in Table 1, scatter plots of individual scores were constructed for each test. Those which best discriminated BAC were chosen for the large-scale evaluation study. It also was considered essential for the battery to represent a variety of skills; some persons are unduly handicapped on certain kinds of tests due to age, physical impairment, or language and cultural barriers. The following include measures of balance, large muscle coordination, cognitive skills and oculomotor control:

One-Leg Stand
Walk and Turn, Heel-Toe
Finger-to-Nose
Finger Count
Alcohol Gaze Nystagmus (AGN)
Tracing

Alternate Tests:

Romberg (Body Sway)
Subtraction
Counting Backwards
Letter Cancellation

(These tests are to be used when some factor precludes using part of all of the regular battery.)

C. Experimental Evaluation

Evaluation of the test battery, as configured on the basis of the literature review and pilot studies, was performed during ten day-long sessions in the SCRI laboratories. Appendix 4 shows the layout of the laboratory for the study. Figure 2 displays the cells of the experimental plan. Participants were categorized as light,

Table 1
Pilot Experiment
Mean Test Scores by BAC Group

Group	n	BAC	Romberg(Body Sway)	Finger-to-Nose	Nystagmus	Tongue Twisters	Walk & Turn	Finger Count	1-Leg Stand
0	10	0	2.00	.80	.85	.40	1.25	.60	1.20
2	10	.10%	5.10	4.05	8.80	1.60	7.80	4.50	5.30
1	10	.14%	4.65	6.05	12.00	2.10	6.80	4.00	6.00

	Subtraction		Tracing*	Letter*	Tapping
	Time	Errors	(Maze)	Cancellation	#
0	16 sec	.4	17.16	22	26.02
2	30.5	2.7	12.80	17.30	25.92
1	49.6	2.1	8.33	16.30	25.63

*High Score = good performance

*Low score = poor performance

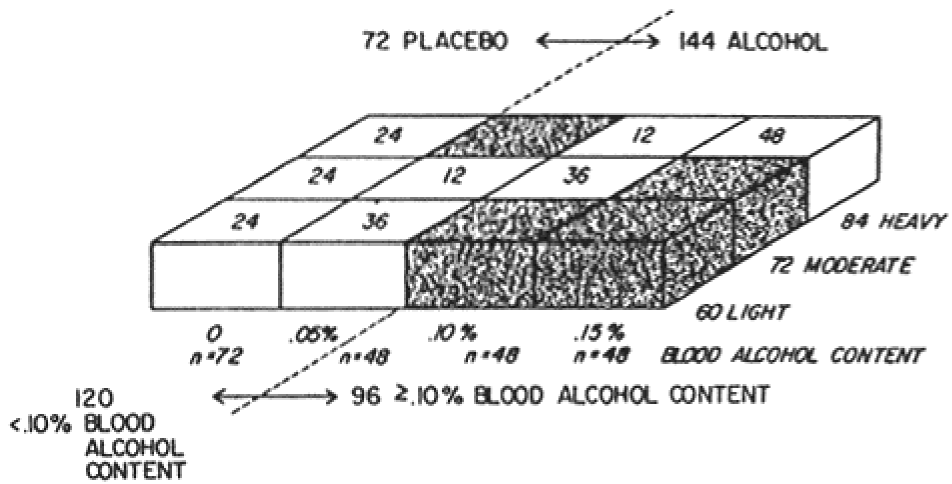


FIGURE 2: Experimental Plan for Participant
Assignment by Q-F-V to Treatment Level

moderate or heavy drinkers by the Quantity-Frequency-Variability Index (Cahalan et al., 1969). They were assigned at random to 0, .05%, .10% or .15% BAC groups with the restrictions that only heavy drinkers were assigned to the .15% group, and light drinkers were assigned only to 0 or. 05% groups. The design permits examination of performance by individuals with widely differing alcohol-use practices at different BAC's.

1. Participants and Officers

The drinking subjects were recruited through the California State Employment Office and were paid $3.00 per hour for participation in one session.

Police officer-examiners were recruited from Los Angeles area agencies and were selected to represent a broad spectrum of experience with DWI testing. This ranged from relatively new officers with less than 200 DWI arrests to veteran officers with as many as 2000 arrests. Appendix 7 tables years of service and DWI arrest experience for the ten officers who participated in the evaluation study.

Each officer attended one training session where he was given intensive instruction in the test administration and scoring procedures developed by SCRI during the pilot studies. The officers practiced administering the test battery using immediate video-feedback. The practice continued until the officer indicated that he felt confident with the procedures and the Project Director judged the officer's level of competence acceptable. Each officer participated in two test days, testing 10-15 persons each day.

2. Apparatus

For the Alcohol Gaze Nystagmus measure a simple device was developed by SCRI which utilizes the position of the small light to control the angle of eye deviation (Figure 3). The individual was asked to cover the left eye and to follow with the right eye the movement of the small light as the examiner moved to it to 30° and 40° positions on the right. He then was asked to cover the right eye, and the same procedure was followed for the left eye in the left visual field. Floor markings were provided for Walk-and-Turn and One-Leg Stand. In addition, vertical wall stripes were used to provide contrast to body movements on videotape. Each examiner was provided with a stopwatch for exact timing of trials. Blood alcohol levels were monitored with a breath sampling gas chromatograph. No other apparatus was required.

It was considered necessary in the context of evaluation to standardize test administration, but all of the tests can be used without special devices or setting. However, it is recommended that a watch be available to precisely time the test trials.

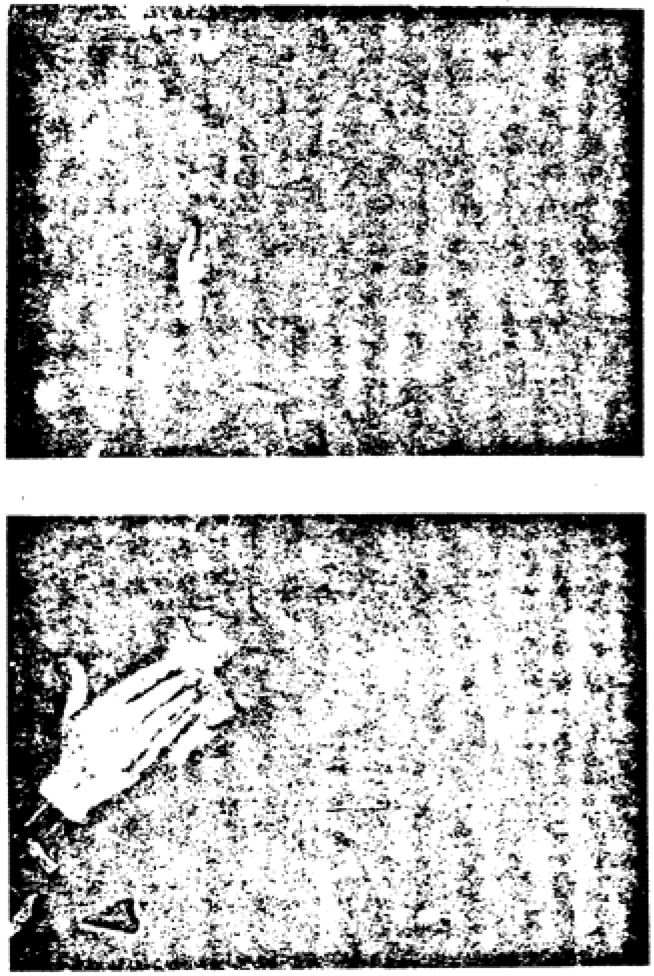


FIGURE 3: Alcohol Gaze Nystagmus (AGN) Apparatus

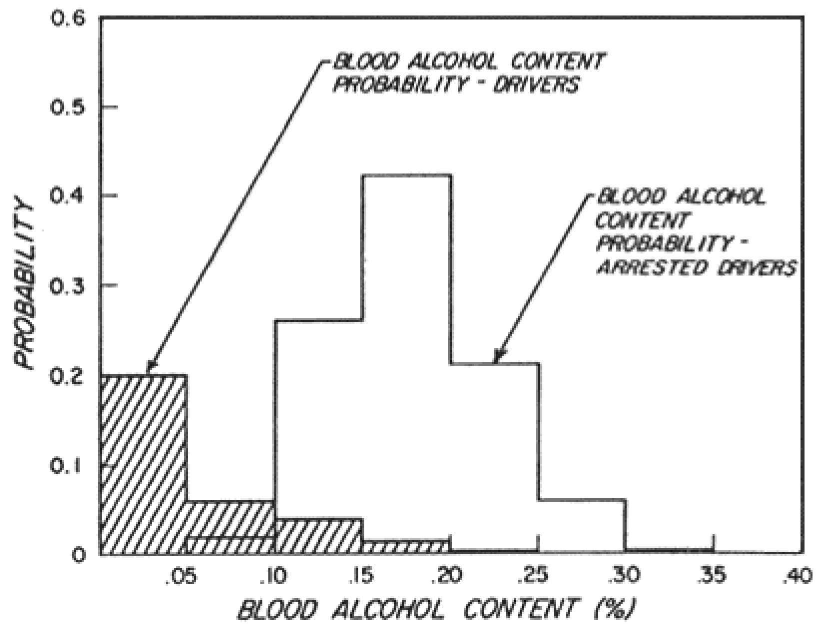


FIGURE 1: BAC Distributions of Two Groups:
Roadside-Survey Drivers and Arrested Drivers

3. Alcohol Treatment

Alcohol was administered in the form of a beverage containing 60% orange juice and 40% eighty proof vodka. The total beverage was given as three drinks over a 1½ hour period. The drinking schedule was adopted as a best compromise between typical social drinking, which may extend over several hours, and the constraints of the experiment schedule. Alcohol doses were calculated by body weight to produce peak BAC's of 0, .05, .10, or .15%.

4. Procedures

Potential participants were interviewed and scheduled by telephone. They were instructed to take no food or stimulants for four hours preceding a session and to abstain from alcohol for 24 hours. These conditions were violated by a number of persons, some arriving with positive BAC's and several admitting to having eaten within the proscribed time. However, for the objectives of this study, these violations were not considered sufficient cause for dismissal, and they were allowed to remain.

The study was performed double-blind. Neither the participants, the police officers, nor the SCRI research assistants knew the alcohol content of the drinks, which were prepared by the Project Director. A small amount of alcohol was floated on the placebo drinks for the 0 BAC group to give the characteristic odor.

Police examiners and observers were separated from the drinking subjects, the treatment preparation area, and the gas chromatograph. Their interactions with the participants were restricted to the time when a research assistant took an individual to the test area. These conditions were very rigidly maintained since it was felt officers might be able to pick up clues about BAC level if permitted to observe participants outside the test area. The intent was that the officer's contact with the participants be closely similar to what would typically occur in the field.

Participants were scheduled to arrive at the SCRI laboratory beginning at 8:00 a.m., with two persons arriving every 15 minutes through 12 noon. Upon arrival the day's procedures were fully explained to the individual, the participant agreement was read and signed, and a breath reading was taken.

The first drink was given within 10-15 minutes of arrival. A 90-minute time period was allowed to complete the drinks, and an additional 30 minutes elapsed to allow further absorption. The second BAC reading was taken 2 hours after beginning to drink. The participant then was taken immediately to the officer-examiner for administration of the test battery. Participants were assigned in advance to groups. Half of each experimental cell on each day were designated Group 1, assigned to Officer 1; half were Group 2, assigned to Officer 2.

As a police officer administered the test battery, one of two SCRI research assistants observed and independently scored the performance of the participants, by the following schedule. Each pair of officers examined participants on 2 successive test days.

	Participants Scored By:
Test Day 1	Officer 1 and Observer 1 or Officer 2 and Observer 2
Test Day 2	Officer 1 and Observer 2 or Officer 2 and Observer 1

The two research assistants who functioned as observers were involved with the development and pilot testing of the battery and are well trained in administration and scoring. The observer procedure was necessary in order to determine whether incorrect arrest/don't arrest decisions by the officers arose from administration/scoring errors or alternately were due to difficulties in discriminating on the basis of a given individual's performance.

Appendix 5 presents the test protocol which examiners followed and the score sheet which was completed for each participant by one officer and one observer. Each test was scored on a 1-10 scale. Examiners and observers also: 1) estimated BAC, 2) indicated whether the person appeared to be alcohol-impaired, and 3) made an arrest/don't arrest decision. A confidence rating was given for each of these judgments on a scale of 1-5, very uncertain to very confident.

A random sample of participants on each test day were video-taped during testing. Also, as discussed in a separate section, a subset of participants were tested with an analogue of the driving task, utilizing the SCRI Stimulus Programming System (SPS).

A participant was released when his BAC declined to .03%.

III. RESULTS AND DISCUSSION

The alcohol impairment test battery was evaluated with 238 drinking participants, 168 men and 70 women. Ages ranged from 20 to 71 years, with a mean of 26 years 6 months and distribution as shown in Figure 4.

These participants were categorized by the Q-F-V index of drinking practices as 62 light drinkers, 86 moderate drinkers and 90 heavy drinkers. Figure 5 shows the Q-F-V distribution by treatment (dose level) group. Some changes from the original experimental plan, as displayed in Figure 2, are evident. These changes and an increase in total N were due principally to a 20% failure-to-appear rate of the scheduled participants. It was not possible to accurately offset the deficit by overscheduling since there was no way to predict which cells would be short of participants. Also, some individuals were either unwilling or unable to drink the amount of alcohol proffered, so their peak BACs fell below the targeted level.

The distribution of mean BACs by test day appears in Table Ia. There was a slight skewing over time, the result of the tendency for heavy drinkers to fail to keep appointments. Because it was repeatedly necessary to reschedule for heavy-drinker cells, more individuals of that classification were tested in the last sessions than during the earlier test days.

Each test was scored on a 0-10 scale where the score increases as a function of more errors/poor performance. The specific nature and number of performance errors associated with a given test score can be obtained from the test record sheet (Appendix 5).

A. Are the Tests Sensitive to Alcohol?

The quantitative data from the evaluation study are summarized in Table 2 and Table 3 and Figure 6 and Figure 7. It is apparent that the tests, as administered and scored by the officer-examiners, and by the observers, generated clearly separated curves for the different BAC levels. All of the tests are sensitive to alcohol, and there is a consistent increase in mean score with increase in mean BAC. Note, however, that these are mean test scores, averaged across participants and officers or observers by actual BAC group. It is necessary next to examine the utility of the tests for deciding individual cases.

B. Do the Tests Discriminate Impaired Drivers?

The officers' scoring of the tests correlated with BAC as follows:

One-Leg Stand	.484	Tracing	.439
Finger-to-Nose	.421	Total Nystagmus	.668
Walk and Turn	.547	Total Score	.669

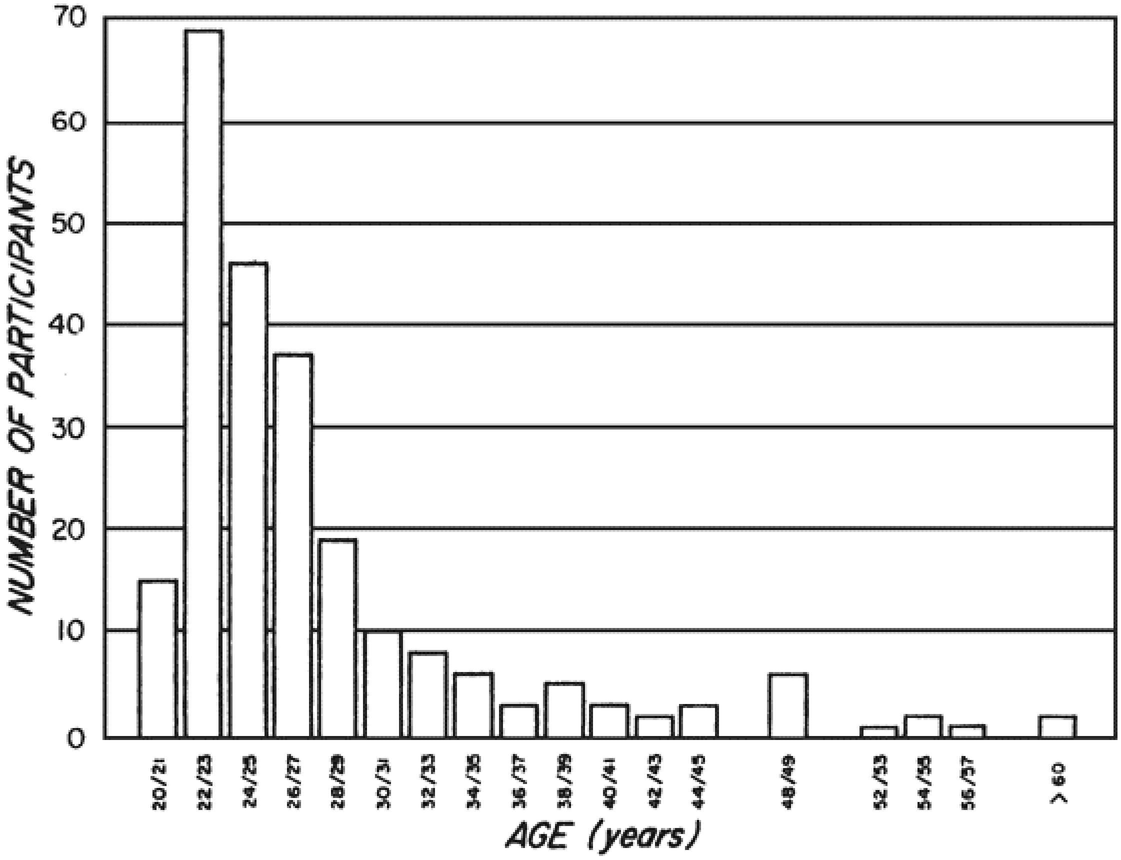


FIGURE 4: Age Distribution of Evaluation Study Participants

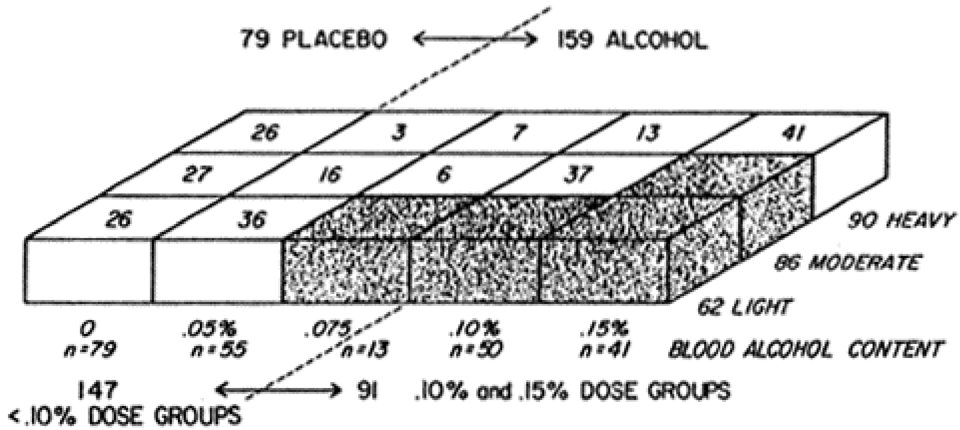


FIGURE 5: Evaluation Study Participants by Q-F-V and BAC

Table 1a
Gender, Age, Q-F-V and BAC
by Test Day and by Officer

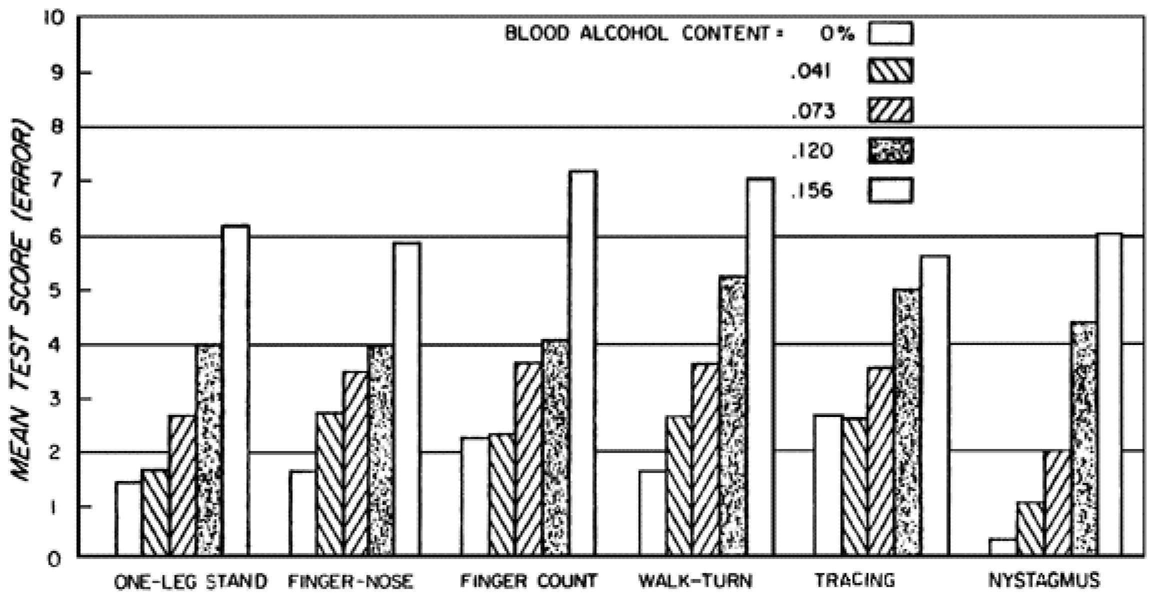
			N			Q-F-V Classification, N			
Test Days	-	Officers	Men	Women	$\bar{x}$Age	Light	Moderate	Heavy	$\bar{x}$BAC
1 & 2	)	1	15	4	27.63	3	7	9	.058
	)	2	18	3	28.19	3	6	12	.074
3 & 4	)	3	20	4	26.42	2	14	8	.053
	)	4	14	7	30.95	5	9	7	.071
5 & 6	)	5	12	8	25.45	7	10	3	.067
	)	6	13	8	26.05	8	8	5	.051
7 & 8	)	7	20	9	28.55	7	10	12	.050
	)	8	16	9	26.36	11	7	7	.054
9 & 10	)	9	25	6	26.06	10	7	14	.073
	)	10	15	12	29.70	6	8	13	.060

Table 2
Officers' Scores and Observers' Scores by BAC (Actual) Groups

	Group 1 0 BAC N=79	Group 2 0<x<.05% N=20	Group 3 .05≤x<.10% N=75	Group 4 .10≤x<.15% N=48	Group 5 x≥.15% N=16
Mean BAC	0	.041%	.073%	.120%	.156%
TESTS:					
<u>10 Officers' Scores</u>					
One-Leg Stand	1.44	1.70	2.68	4.06	6.33
Finger-to-Nose	1.64	2.57	3.46	4.00	5.93
Finger Count	2.31	2.38	3.74	4.15	7.31
Walk and Turn	1.72	2.70	3.72	5.32	7.13
Tracing	2.73	2.62	3.80	5.04	5.75
Nystagmus					
Left	0.36	0.95	2.13	4.36	6.25
Right	0.29	1.05	1.93	4.53	6.06
Total	0.65	2.00	4.06	8.89	12.31
Total Score:	10.49	13.97	21.46	31.46	44.76
<u>2 Observers' Scores</u>					
One-Leg Stand	1.79	1.70	2.66	3.85	6.40
Finger-to-Nose	1.71	2.52	2.60	3.83	6.67
Finger Count	2.25	2.57	3.63	3.87	6.56
Walk and Turn	2.20	3.20	3.62	5.26	7.33
Tracing	2.73	2.62	3.74	5.04	5.88
Nystagmus					
Left	0.44	0.95	2.01	5.32	6.13
Right	0.31	1.24	2.06	4.81	6.31
Total	0.75	2.19	4.07	10.13	12.44
Total Score:	11.43	14.80	20.32	31.98	45.28

Table 3
Data Summary: <.10% BAC, ≥.10% BAC
and Total Sample

	<.10% BAC		≥.10%BAC		Total Sample	
	mean	σ	mean	σ	mean	σ
10 Officers' Scoring						
Test:						
One-Leg Stand	2.01	2.36	4.61	3.20	2.69	2.84
Finger-to-Nose	2.54	2.38	4.47	2.73	3.04	2.61
Finger Count	2.94	3.54	4.95	3.96	3.47	3.76
Walk & Turn, Heel-Toe	2.71	2.75	5.75	3.22	3.51	3.17
Tracing	3.18	1.91	5.21	2.49	3.72	2.27
Nystagmus - Left	1.20	2.01	4.84	3.07	2.16	2.83
- Right	1.10	1.89	4.92	3.16	2.11	2.85
- Total	2.30	3.71	9.76	6.00	4.27	5.52
Total Test Battery Score:	15.68	11.09	34.76	13.85	20.70	14.56
2 Observers' Scoring						
Test:						
One-Leg Stand	2.14	1.98	4.47	2.85	2.78	2.47
Finger-to-Nose	2.19	1.74	4.52	2.53	2.82	2.23
Finger Count	2.87	3.50	4.55	3.98	3.33	3.71
Walk & Turn, Heel-Toe	2.92	2.34	5.75	2.95	3.69	2.82
Tracing	3.14	1.93	5.25	2.48	3.72	2.29
Nystagmus - Left	1.68	2.05	5.52	3.14	2.36	3.08
- Right	1.16	2.01	5.19	3.26	2.27	3.01
- Total	2.34	3.75	10.71	5.77	4.63	5.77
Total Test Battery Score:	15.60	9.39	35.25	13.10	20.97	13.67



BLOOD ALCOHOL CONTENT = 0%
.041
.073
.120
.156
MEAN TEST SCORE (ERROR)
ONE-LEG STAND
FINGER-NOSE
FINGER COUNT
WALK-TURN
TRACING
NYSTAGMUS

FIGURE 6: Mean Test Scores by BAC Group

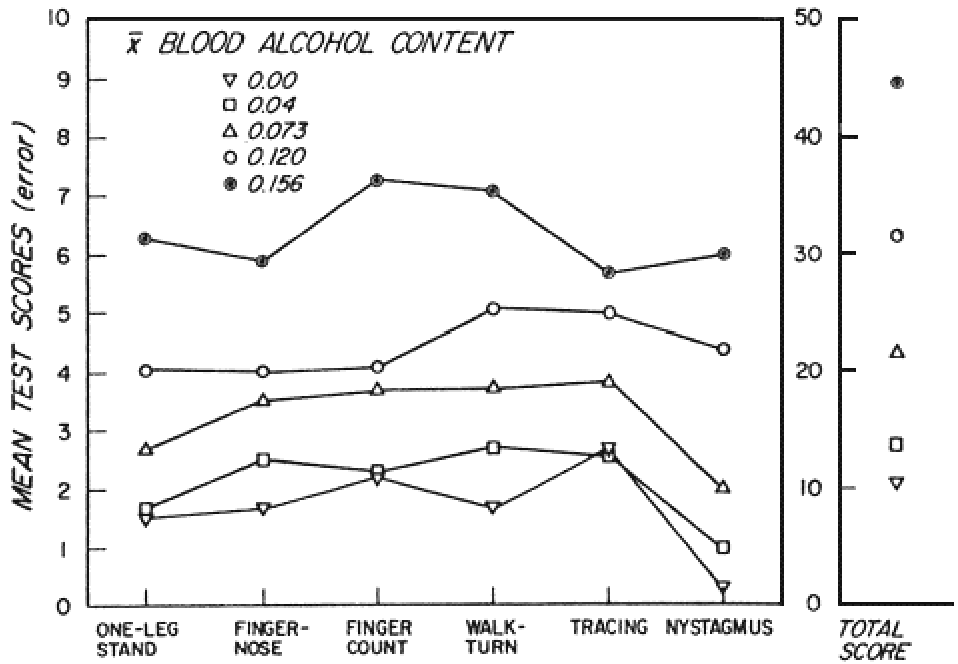


FIGURE 7: Performance Curves by BAC Group

The question of primary interest then is whether the officers were able to make the correct decision, that is, to arrest these persons at or above .10% BAC or to not arrest those below .10%, based on test performance. Their decisions are represented in the matrix below:

	OFFICERS' DECISIONS			
	Arrest	Don't Arrest		% Correct Decisions
≥.10%	Hit n = 54	False Negative n = 10	64	84
≥.10%	False Alarm n = 47	Correct Rejection n = 127	174	73
	101	137		
% Correct Decisions	53	93		76

At BACs ≥.10% the officers correctly decided to arrest 84% of the cases, and for BACs <.10% They made the correct decision to release 73% of the time. However, note that the officers indicated they would have arrested 101 persons, 47 of whom had BACs below .10%. Obviously, an error rate of 47% in making arrests is not acceptable. Actually, officers in the field are reluctant to err in the direction of false alarms, and observations indicate that the most common error probably is a false negative. In the laboratory where the same consequences do not ensue from false alarm decisions to arrest, there was a tendency to be less conservative and to lower the criterion for arrest.

There is a fundamental problem for the officers, stemming from the fact that BAC is a continuously distributed measure. As with any such distribution there is a limit on the related decision process, because the human organism can discriminate accurately only a limited number of points on such a scale. Since .10% is an arbitrary level which does not coincide with the onset of impairment, the difficulty of the task of categorizing DWI suspects is increased. If the officer was required simply to decide whether or not a driver showed impairment, or if the criterion BAC was closer to the point where impairment initially is apparent, there would be fewer decision errors at roadside.

It is of interest to examine the various possible sources of incorrect decisions about BAC and impairment. Some individuals, notably experienced heavy drinkers, are able to maintain the skills which are tapped by sobriety tests even at very high BACs. Hurst and Bagley (1972) reported acute adaptation to alcohol impairment on both cognitive and perceptual-motor measures. Moskowitz, Daily and Henderson (1974) also found evidence for acute tolerance, as well as the long-term chronic tolerance which reflects drinking history.

Very light or infrequent drinkers may show impairment after drinking a small amount of alcohol. Also, poor performance may be attributable to physical causes other than alcohol. Certain diseases, neurological impairment and aging processes interfere with motor skills. It is also the case that officers may base assessments of intoxication on behavioral cues which are not derived from the tests.

A breakdown of decision errors identifies some areas of difficulty. For example, the following six people received no alcohol but the officers indicated they would have arrested them:

Q-F-V Category	Age	Sex	Nystagmus Score	Total Test Score
Heavy	22	M	0	31
Heavy	48	M	0	27
Heavy	26	M	0	19
Heavy	24	M	5	23
Heavy	45	F	1	16
Light	30	M	1	19

The moderate-to-High total test scores reflect problems with balance and walking, which appear to have been interpreted as alcohol-related. That conclusion certainly was not unreasonable, particularly since these individuals tended to behave as though intoxicated. They were rather loud and jocular, bantering with the examiner in a party-like manner. What is of note here is that if the officers had felt confident with the nystagmus measure, which was new to most of them, but which accurately reflected the level of intoxication, in five cases they would have been less likely to make the decision to arrest.

The individual with the higher nystagmus measure was a very unusual man whose general behavior was strange. It is possible that he suffers some neurological impairment.

It is of interest to note that the observers would have made only one arrest in this group, the light drinker, who was given a total score of 25 and a nystagmus score of 2 by the observer.

The officers also made six incorrect decisions to arrest men who received small amounts of alcohol, as follows:

Q-F-V Category	BAC	Age	Nystagmus Score	Total Test Score
Heavy	.049	39	0	25
Heavy	.047	22	7	27
Moderate	.050	23	5	18
Moderate	.048	25	4	14
Moderate	.046	23	0	9
Moderate	.045	33	0	6

It is puzzling why decisions were made to arrest the two moderate drinkers who were given low total scores and who had no nystagmus. Apparently the officers disregarded test evidence and based their decisions on some other cues.

As with the 0 BAC group there were some highly unusual individuals among these men. For example, the 39 yr. old heavy drinker was scheduled to achieve .15% but in a hostile manner refused drinks after the first one. He showed distinct physical impairment which probably had no relation to the small amount of alcohol which he consumed. He was the only one in the group who would have been arrested by the observer.

Appendix 6 shows all false arrest decisions, that is, those cases where the officer indicated the person would be arrested but the BAC was less than .10%. It should be pointed out that 24 of these were administered alcohol doses calculated to produce .10% BAC, but the gas chromatograph reading fell short of the mark. The lower measured BAC may have resulted from inaccuracies in reported body-weight or because individuals had consumed food contrary to instructions. Also, some machine measurement error is possible. With the large number of participants at each session it was not practical to give booster treatments and disrupt the tightly scheduled administration of tests. It should be kept in mind that by dose level the officers were not in error as regards these participants. The important issue here, and one that appears consistently through-out these data, is that the decision errors occurred in relation to individuals whose BAC was just below .10%.

For most of the cases listed in Appendix 6 there was evidence of impairment as indicated by the total test score, and the jerking movement of the eyes (nystagmus) was observed. The officer's decision then is not at odds with evidence from the test battery. As discussed elsewhere and as apparent in the false alarms, decision errors occur most often with middle range levels of intoxication. Quite simply, there are no behavioral cue which differentiate infallibly in a ± .02% BAC margin.

In summary, analysis of false arrest decisions indicates at least four sources of errors in decision, assuming ≥. 10% is correct:

1. Borderline BAC levels.
2. Failure by the officer to heed the lack of test evidence for intoxication.
3. Impairment which is not alcohol-related.
4. Unusual individuals whose manner and appearance suggest intoxication.

The data show two basic kinds of errors. In one case the quantitative score did not reflect the measured BAC, either because the officer did not score properly or the performance was atypical. The second kind of error occurred when the score was appropriate to the performance expected for a given BAC, but the officer's decision was at odds with the score.

The officers' errors were almost evenly divided between the two possible kinds. For roughly half the participants the scores do not appear to represent the performance accurately, and for the other half the officer's decision doesn't mirror the score.

C. Criterion Score

An important objective is to locate a criterion score, which will dichotomize the BAC distribution into above and below .10%. An initial approach utilized a linear regression analysis, as graphed in Figure 8. As can be seen in the figure, this analysis locates the criterion at a total score of 28. On the assumption that the person who scored 28 or more was at .10% BAC or higher, and that a score of less than 28 indicated a BAC lower than .10%, the following matrix is generated (borderline cases are assumed to fall into the non-error category):

CRITERION SCORE CLASSIFICATIONS				
	Arrest Score ≥28	Don't Arrest Score <28		% Correct Classifications
≥ .10%	44	20	64	69
< .10%	20	154	174	89
	64	174		
% Correct Classifications	69	89		83

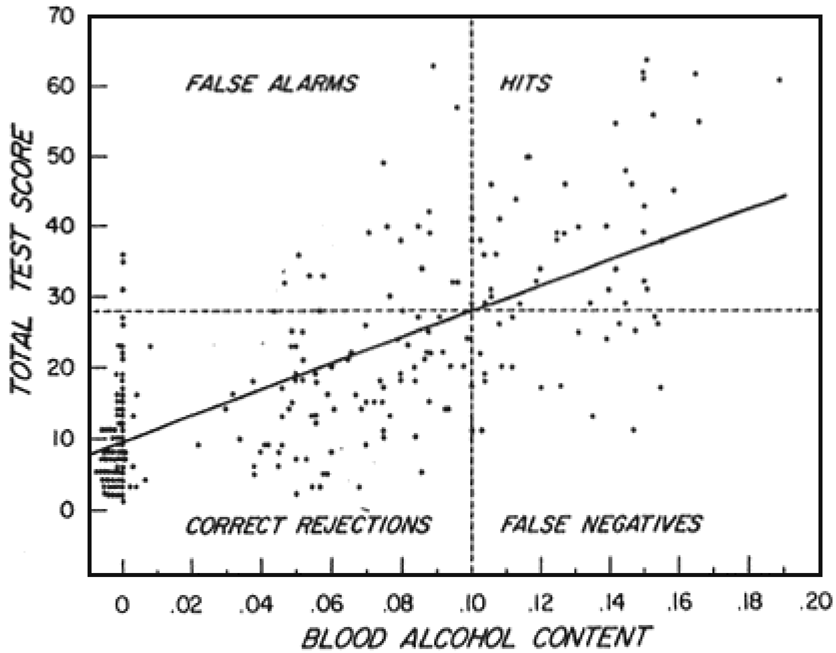


FIGURE 8: Scatter Plot of Total Score vs. BAC

PSYCHOPHYSICAL TESTS FOR DWI ARREST
Author's Marcelline Burns & Herbert Moskowitz
Contract or Grant No. DOT-HS-5-01242
PDF page 36

Compared to the officers' decisions, this total score criterion yields more correct decisions overall, 198 vs 181, 83% vs 76%. Compared to other possible criterion scores, the use of the score 28 maximizes both the total number of correct decisions overall and the percent correct for arrest decisions.

It is of further interest to compare each cell of the matrix from the officers' scores with the matrix from the criterion score, as follows:

	Officers' Decisions	Classification by Criterion Score
Arrest Decisions:	%	%
Correct (Hits)	53.5	69
Errors (False Alarms)	46.5	31
Don't Arrest Decisions		
Correct (Correct Rejections)	93	89
Errors (False Negatives)	7	11

As discussed previously, almost half of the officers' decisions to arrest were erroneous. Their high false alarm rate is not typical of officers' decisions in the field, and it probably reflects a relaxed or lowered decision criterion. That is, in the laboratory they were willing to make an "arrest" decision on less evidence than they would require in a real-world situation. A stricter decision criterion would, of course, affect both kinds of errors, reducing false arrests, increasing false negatives. In actual practice, the most common error at roadside is a false negative; unless an officer has a high degree of certainty that an individual's BAC is over .10%, he is most likely to release rather than arrest.

There were four high BACs (>.15%) for which the associated total test score did not exceed the criterion score of 28. The individual differences in skill and in response to alcohol which underlie these misclassifications inevitably will be troublesome for a quantified test battery. A case in point is the male participant, age 28, whose drinking practices categorized him as a heavy drinker. He was of muscular build and appeared to be in top physical condition. His peak BAC reading was .147%, but there was no sign of intoxication in test performance, speech, or appearance. At the other extreme, a female, age 63, appeared to be intoxicated at .067% BAC, and could not perform the balance or walking tests. She is a light drinker, and she is arthritic.

Also, the accuracy of classification inevitably will be limited because of the form of the underlying distributions. In effect, we are attempting to classify continuous variables into discrete cells of the 2 x 2 matrix. Those cases which cluster near the criterion BAC or the criterion test score are particularly subject to classification error. Consider, for example, what performance differences could reasonably be expected between BACs of .095% and .105%? Observe that in the distribution graphed in Figure 8, 40% of the false alarm decisions and 45% of the false negative decisions occur within a ± .02% margin around the .10% limit.

D. Comparison of Officer and Observer Scores

Between-examiner consistency is of considerable interest in the examination of errors. As an officer administered and scored the tests, the participants' performance also was observed by an SCRI research assistant, and the two sets of scores can be compared.

The two persons, observer and officer, were able to watch a participant, independently evaluate the test performance, and arrive at closely similar decisions about impairment. Figure 9 graphs a comparison of the scoring by the ten officers and two observers. The scores correlate overall with r = .92 (Table 4).

The following cases were incorrectly classified by both the officer and observer:

False Alarms (BAC <.10% & Decision to Arrest		False Negatives (BBC ≥. 10% and Decision to Not Arrest)	
Participant's Q-F-V Category	Measured BAC	Participant's Q-F-V Category	Measured BAC
Heavy	.096	Heavy	.147
Heavy	.093	Heavy	.126
Heavy	.080	Heavy	.118
Moderate	.098	Moderate	.104
Moderate	.095	Moderate	.103
Moderate	.088	Moderate	.100
Moderate	.086		
Moderate	.075		
Moderate	.074		
Moderate	.056		
Light	.067		
Light	.054		

In 29 cases the officers' and observers' decisions differed. For 10 of these disagreements the officers were correct, and for 19 they were in error, including 16 wrong decisions to arrest and 3 wrong decisions to release. For the 10 cases which were observer errors, five were false-alarm arrests and five were false-negative releases.

Again, the source of errors in more than half of these cases appears to be that borderline BACs cannot be discriminated from each other. It is possible to identify a low or high BAC, usually with a high degree of certainty, but difficulties arise, for example, when a person at .098% shows impairment in performing the tests but the person at .103% does not.

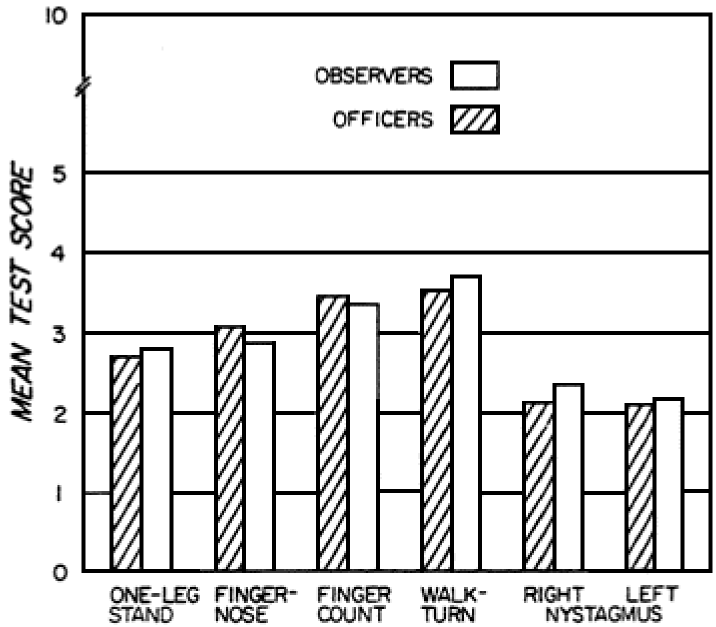


FIGURE 9: Mean Test Scores, as Scored by Officers and Observers

Table 4
Officer - Observer Test Score Correlations

Test	Participants (by BAC)		All Participants
	<.10%	≥.10%	
One-Leg Stand	.77	.81	.82
Finger-to-Nose	.60	.72	.70
Finger Count	.87	.79	.85
Walk & Turn, Heel-Toe	.70	.84	.80
Nystagmus - Left	.85	.72	.86
- Right	.83	.75	.86
- Total	.88	.78	.90
TOTAL TEST SCORE:	.88	.89	.92

E. Tolerance to Alcohol Effects

The literature on chronic use of alcohol demonstrates that resistance to alcohol impairment is a function of drinking frequency and history (Moskowitz, Daily and Henderson, 1974; Kalant, LeBlanc and Gibbons, 1971; Goldberg, 1943). This phenomenon of chronic tolerance creates an additional difficulty for sobriety testing. Widely differing drinking practices among drivers can be expected to give rise to different BAC points of impairment of test performance.

The regression analysis, as discussed previously, used a first-degree (linear) equation to examine the relationship between BAC and test score. However, in order to locate the exact BAC at which substantial impairment initially appears, a polynomial regression analysis (computer program BMDP6R) was performed to fit second-degree (quadratic) curves to the data.

The polynomial analysis was carried out separately for light, moderate and heavy drinkers, and the quadratic curves appear in Figure 10. It can be observed that the point of initial, substantial impairment, as indicated by a change in slope, varies as a function of drinking practices. Impairment appears well below .05% for light drinkers and is clearcut for moderate drinkers by .07%.

Heavy drinkers show relatively poor performance, in comparison to the other drinking groups, at any given BAC. This reflects in part the older ages of the heavy drinkers, as well as physical deterioration associated with long-term chronic drinking.

This analysis provides additional evidence that the point of a sharp increase in alcohol impairment varies according to the individual's drinking history. It also strongly suggests that the arbitrary DWI level of .10% is considerably beyond the point of serious impairment for most people, and that .08% would be a more reasonable level. The following section examines the utility of the test battery and a criterion score for discriminating between above and below .08%.

F. A Question of BAC Limit

A BAC of .10% is widely used as the point at which an individual can be charged with driving under the influence of alcohol or driving while impaired, and this report focuses for the most part on an assessment of the test battery based on that level of blood alcohol. Do the tests discriminate drivers whose BAC is above .10% from those who are below that level? This is the currently relevant question in terms of the utility of the tests for law enforcement, but there are other important questions.

In particular, there is considerable evidence in the data, as discussed elsewhere in this report, that the .10% level is not the point of initial, serious impairment for many drivers, and that

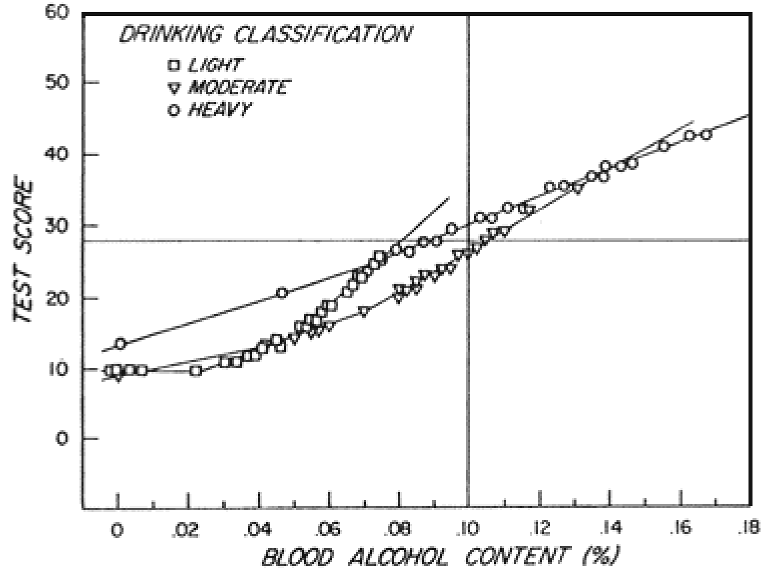


FIGURE 10: BAC vs. Total Test Score, by Drinking Classification (Q-F-V)

it may in fact be substantially lower. If the officers' decisions are sensitive indicators in that they adopt a criterion reflecting the lower BAC level where they first observe impairment, then their false-alarm rate is explicable. It actually may be an artifact of the arbitrary .10% BAC. This issue can be examined by constructing a matrix for a lower BAC, as in the following which is based on .08%.

	OFFICERS' DECISIONS			
	Arrest	Don't Arrest		% Correct Decisions
≥ .08%	71	22	93	76
< .08%	30	115	145	79
	101	137	238	
% Correct Decisions	70	84		78

A comparison of the above with the matrix based on .10% (page 25) suggests that the officers were making decisions "as though" .08% BAC were the limit. It is not likely that they consciously and deliberately departed from a .10% criterion. Rather it may be that they consistently noted impaired performance at the lower level and equated it in the decision-making process with the point for arrest.

If the analysis is extended to the criterion score, there is further evidence to suggest that .08% is an appropriate level which more effectively divides seriously impaired drivers from those who are less or non-impaired.

The matrix on page 28, based on a score of 28 and a BAC of .10%, shows 69% of the arrests would be correct. If on the other hand the BAC criterion were .08%, the criterion score becomes 25, and as can be seen below, 77% of the arrests would be correct. In other words, the quantitative scores accurately reflect the impairment which appears not at the legal limit but at lower levels.

	CRITERION SCORE					
	Arrest ≥25		Don't Arrest <25			% Correct Decisions
≥.08%	Hit	64	False Neg.	29	93	69
<.08%	False Arrest	19	Corr. Rej.	126	145	87
		83		155	238	
% Correct Decisions		77		81		80

In summary, it appears that the .10% BAC level is at odds with the observation and scoring of impaired performance. The consequence is that decisions are wrong in terms of the legal limit but are quite correct in terms of driving impairment.

G. Selection of a Final Test Battery

The key question for the project centers on the practical utility of the test battery. The police officer in the field is confronted with the single individual. He must make a decision to arrest or to release. If he arrests, he may later be required to present as evidence in court proceedings a report of the behavior which led him to make the arrest. The test battery has value for the officer only if it: 1) facilitates his arrest/release decision, and 2) enables him to give credible and convincing testimony in court.

The evaluation data demonstrate that the six tests which were studied can be used as a battery to assist officers in determination of drivers' levels of intoxication. However, the 6-test battery is too lengthy for roadside use. Careful administration of the entire battery, including demonstrations and thoughtful scoring, requires a minimum of 15 minutes. Officers typically do not allot that much time to roadside examination of a driver, and it is essential to select a subset of these tests which as a shorter battery will still fulfill the objectives of sobriety testing.

Selection of the final test battery has been accomplished by step-wise discriminant analysis, utilizing program BMDP7M from BioMedical Computer Programs. The discriminant model derives linear functions of the test battery scores so as to best separate the BAC groups. The success depends on the overlap of the distribution of scores generated by the test battery for each group. If there are many scores in common, there will be many wrong decisions. If the final test battery can be configured to yield scores with little overlap, then there will be few errors. This has been illustrated with clarity by Cooley and Lohnes (1971) (see Figure 11), who describe the graphic representation as follows:

> ". . . the two sets of concentric ellipses represent the bivariate swarms for the two groups in idealized form. . . Each ellipse is the locus of points of equal density (or frequency) for a group. . . The two points at which corresponding centours intersect define a straight line, II. If a second line, I, is constructed perpendicular to line II, and if the points in the two-dimensional space are projected onto I, the overlap between the two groups will be smaller than for any other possible line. The discriminant function therefore transforms the individual test score to a single discriminant score, and that score is the individual's location along line I." (P. 245)

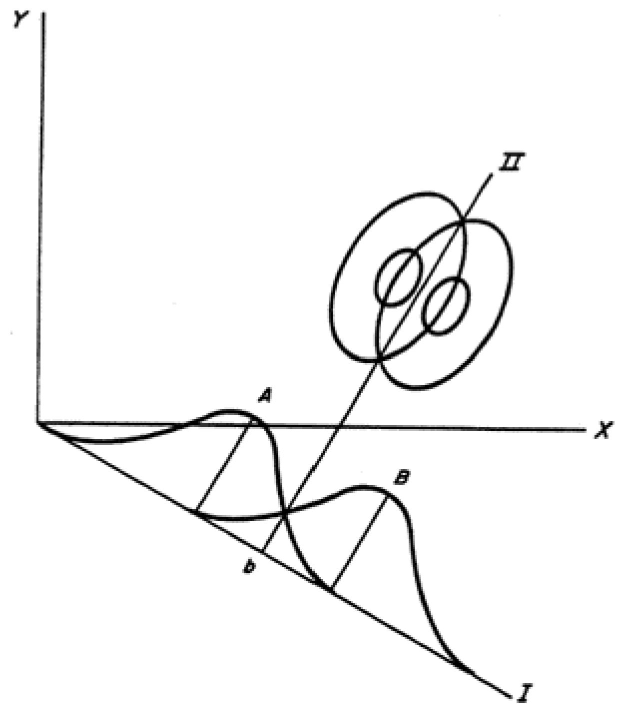


FIGURE 11: Graphic Representation of Discriminant Model (Cooley and Lohnes, 1971)

BMDP7M computes the set of linear classification functions by choosing variables in a stepwise manner. At each step the variable with the highest F (standard F statistic, hypothesis of equality) is chosen. Using specified prior probabilities and pooled within group variances, group classification functions are obtained and a classification table is produced.

Appendix 8 summarizes the classification tables obtained from a series of analyses with BMDP7M. On an initial run, all test scores were entered as variables for the analysis. Then various combinations of reduced test sets were explored in an effort to locate the optimal tradeoff between test battery length and percent correct classifications.

When all tests were entered as variables, the classification utilized scores from the following tests: total nystagmus, tracing, walk and turn, finger count, nystagmus-left eye, and one-leg stand. Almost 85% of the participants were correctly classified into the two BAC groups, above .10% (70% correct) and below .10% (90% correct). However, this is a relatively long battery, and the tracing test cannot easily be used at roadside.

At the other extreme, if only a <u>single test</u> is used, these data can be classified as follows:

Test	% Overall Correct	% <.10% Correct	% ≥.10% Correct
Walk and Turn	75.1	80.0	59.7
Finger-to-Nose	70.4	75.6	56.5
Finger Count	67.1	70.8	57.1
Tracing	76.5	84.4	55.6
One-Leg Stand	75.5	79.6	64.5
Nystagmus - left	80.1	89.9	54.0
- right	82.7	87.5	69.8
- total	81.8	86.9	68.3

The nystagmus measure is superior to any other single test and compares favorably to a long battery. (Note: the differences between left and right eye seem to be due primarily to vision problems. e.g., restricted vision in one eye due to brain injury, one artificial eye, etc.)

Table 5 gives the distribution of nystagmus scores. The criterion employed by the discriminant analysis was that a score ≥ 6 placed the person in the ≥.10% BAC group. As can be seen in the table, this criterion incorrectly classified 23 (13%) of the <.10% group and 21 (33%) of the ≥.10% group for an overall error of 18%.

However, predictors which have the highest correlations with a criterion variable, in this case correlation of tests with BAC, when considered singly may have little value in a combination of

Table 5
Distribution of Total Nystagmus Scores by BAC Group

Point Score	BAC Group <.10%		BAC Group ≥.10%		% of Participants at Each Point Score	
10 pts. per eye, max.=20	n	%	n	%	<.10%	≥.10%
0	92	52.6	2	3.2	98	2
1 - 5	59	33.9	19	29.7	76	24
6 - 10	19	10.9	17	26.9	53	47
11 - 15	1	.5	11	17.5	8	92
16 - 20	3	1.7	15	23.8	17	83
	174	100.0	64	100.0		

predictor variables. In order to locate an optimal combination of tests, the discriminant analysis was performed with various test sets (Appendix 8). The total score derived from the three measures, walk and turn, one-leg stand, and total nystagmus, appears to be the best predictor.

For these data, 83.4 percent correct classifications were made, with 68 percent correct arrests. This is essentially the same level as obtained with the entire battery. The involuntary jerking movement of the eyes (nystagmus), together with balance and walking problems, provide the examiner with information about three different indices of intoxication. An idiosyncratic response in one area probably will be balanced by a more typical response in another. Testing can be performed in any environment and requires less than five minutes. Also, use of the total score, rather than a number of single-test scores, facilitates the location of cutoff scores and probability levels.

A number of the same participants are consistently classified incorrectly by stepwise discriminant analyses, even though the subsets of scores entered into the analyses are varied across the range of possibilities (Table 6). It is of interest to examine these cases which it seems impossible to capture within a classification scheme. A participant's behavior may have been atypical, or the scores may not be an adequate representation of his performance.

It is important to first note that half of the cases shown in Table 6 fall into the BAC range .08-.12%. Again, it should be pointed out that all the evidence from these data suggests it is unrealistic to attempt to use behavioral tests to discriminate BACs in a ± .02% margin around a given level.

It proves to be highly informative to examine the misclassifications for the cases with BACs outside the .08-.10% range. Observe in Table 6 that eight participants with BACs <.08% were classified ≥.10%. Six of these were light drinkers, and the misclassification demonstrates their lack of tolerance to alcohol. On the other hand, ten people at BACs >.12% were classified as <.10%. All were heavy drinkers whose drinking experience appears to have led to the development of a chronic tolerance to the impairing effects of alcohol.

In summary, the discriminant analyses confirm findings which have emerged from other examinations of these data. Some individuals perform in a manner which appears not to be congruent with BAC level but which frequently is explicable in terms of a tolerance effect. These individuals inevitably will present a problem for any system of testing and scoring, as well as for the police officer, who rarely will have information about the person's drinking history.

Table 6
Summary for Participants Mis-Classified
by Discriminant Function Analysis

	Q-F-V Category	Total Nystagmus	Total Score	% BAC
Participants <.10% (Classified ≥.10%)	Light	9	23	.049
		8	25	.052
		20	33	.054
		10	19	.056
		6	28	.057
		13	49	.075
	Moderate	8	30	.077
		10	40	.085
		6	34	.086
		17	42	.088
		8	27	.091
		10	20	.098
	Heavy	4	39	.071
		8	19	.081
		10	39	.088
		20	62	.093
		9	33	.095
		16	57	.096

(continued)

Table 6 (continued)
Summary for Participants Mis-Classified
by Discriminant Function Analysis

	Q-F-V Category	Total Nystagmus	Total Score	% BAC
Participants ≥.10% (Classified <.10%)	Moderate	0	11	.100
		6	11	.103
		2	19	.104
		4	26	.108
		3	27	.112
	Heavy	4	36	.107
		5	20	.112
		0	17	.118
		4	17	.126
		4	25	.131
		5	29	.135
		2	13	.135
		2	26	.143
		3	11	.147
		4	32	.150
		4	27	.153
		4	26	.154
		4	17	.155

However, training in sobriety testing should acquaint the officer with the phenomenon of tolerance, so he can bring that information to bear in cases of uncertainty. On such occasions the DWI suspect's age and appearance and the locale will sometimes provide clues about the person's drinking habits.

H. Officer Experience and Training

Correlational analyses were performed to determine the relationship between a police officer's experience and his skill in assessing whether a participant should be arrested. Spearman rank-difference correlations revealed that the officer with the most experience and the second largest number of DWI arrests made the most correct decisions as to arrest/don't arrest. Also, his scoring of participants' test performances yielded the highest correlations (Pearson r) with BAC. Further, an examination of data, grouped by the law-enforcement agencies which the officers represented, showed that this man and his fellow officer were more skilled than the officers from other agencies. A key factor undoubtedly is assignment to DWI patrol where their sole regular responsibility is detection and arrest of intoxicated drivers.

Beyond these findings there were no additional significant relationships between experience and skill. Attitude and interest in the project varied considerably between officers, and it is believed that these variables had as much influence on decision processes and success rate as did the variable of experience.

If a test battery is to be widely useful and acceptable, it is important to be able to train officers in administration and scoring procedures in a relatively short period of time. Each pair of officers who participated in the study came to SCRI for a single training day during the week immediately preceding the validation sessions. They were given a general orientation to the purposes of the project, followed by specific instructions on administering the test battery. Correct administration was demonstrated, and then the officers practiced those exact procedures under supervision. A videotape system was used to facilitate learning.

When an acceptable level of administration of the tests was achieved, the scoring system was introduced. Again under supervision, the officers practiced testing and scoring. In all cases it was possible to train the men to follow the required testing procedures and to enable them to feel comfortable with the rather rigid instructions within 4-5 hours. The training procedure provided an opportunity for the officers to observe test performance by individuals at zero BAC. They thus were able to establish some standards of performance by which to gauge the study participants. It is extremely important that training in the use of tests of alcohol-related impairment be planned to include a range of BACs with immediate feedback to the officers.

A training period of one day or less probably is not prohibitively long. The question then concerns the level of competence demonstrated during the evaluation sessions. One approach to this question is to compare their scoring records with those of the two observers. The observers were SCRI research assistants who were involved with the project from the beginning. They performed the testing during the pilot studies, and they supervised the officers' practice during training.

The ten officer's scoring (total test score) correlated .699 with BAC. The equivalent correlation for the two observers was .727. Since the observers were involved with recruiting and scheduling participants, they had some knowledge of probable BAC levels and thus some advantage over the officers. Of course, it also is true that none of the officers were total novices, all having had training and experience with the balance and walking tests, as well as considerable skill in observation and experience in judging impairment under alcohol.

It is concluded that a short, intensive training in standard administration and scoring of the test battery is adequate. The ten officers, representing several agencies and a wide range of experience, demonstrated an acceptable level of competence in the laboratory following one training session.

I. Comparisons with Finnish Data

The study carried out by SCRI is similar in scope and methodology to a study of DWI tests by Pentillä, Tenhu and Kataja (1974) which examined the impairment-test records of 495 Finnish drivers. In Finland the examinations for intoxication are carried out by physicians, and the system utilizes 15 tests which are scored on a 0-3 scale. The investigators used the records of these examinations to develop a series of point value models in an attempt to standardize the physicians' evaluations in relation to BAC.

There is considerable similarity between the Finnish and the SCRI studies, and Table 7 presents correlations from each set of data where comparisons of similar tasks are involved. However, there also are basic differences which are pertinent to interpretations of the data. The participants for Pentillä, et al., were drivers who the police suspected of drunk driving, and the examiners were physicians highly experienced with the tests. Only 22% of the drivers were at a BAC lower than .10%. For the SCRI study, paid volunteers were administered alcohol, and the ratio of BACs below .10% to BACs above .10% was established at approximately 3:1 in order to avoid biasing the examiners to expect intoxication. Examiners were police officers with varying skill levels derived from minimum field experience at one extreme to DWI specialists at the other. Only two of the officers had prior experience with examining the eyes for nystagmus.

Table 7
Correlations Between Test Scores and BAC

Finnish Data		SCRI Data	
BAC	0-.30+%	BAC	0-.15+%
N	495		238
Tests:	r	Tests:	r
Walking along a line	.55	Walk and Turn	.55
Gait in turning	.50		
Romberg (body sway) with eyes open	.59	One-Leg Stand.	.48
Finger-finger test	.36	Finger-to-Nose.	.47
Nystagmus	.48	Nystagmus - Left Eye	.64
		- Right Eye	.65
		- Both Eyes	.67
Six-Test Battery	.715	Total Score, All Tests	.699
		Total Score (Walk and Turn, One-Leg Stand and Total Nystagmus)	.702

The Finnish report states: "The cases with an obvious disease, ingestion of drugs, injuries, disabilities or fatigue affecting the test performance in some way were omitted from the material." These restrictions were not imposed for selection of SCRI participants since the intent was to sample the entire population of drivers who police officers may have occasion to test. These differences should bear upon interpretation of the respective findings. The task of the Finnish investigators was easier in that all the cases were drivers presumed to be drunk.

From the study of drivers in Finland the investigators conclude that the following comprise an optimal test battery:

1. Walking along a line
2. Romberg's test with eyes open
3. Counting backwards
4. Collecting small objects
5. Nystagmus after movement of the eyes
6. Time to onset of nystagmus after rotation of the individual.

The correlation coefficient of this battery with blood alcohol was .715. As alternate or additional tests, the following are specified: Walking test with eyes closed, Gait in turning, Finger-finger tests, and Orientation as to time.

Tests No. 3 and 4 were pilot-tested at SCRI, but the results did not warrant retaining them in the battery. Test No. 2 also was pilot-tested (as Romberg, eyes closed), and was found to be a sensitive measure which is offered as an alternate test for the battery proposed by SCRI. However, One-Leg Stand also involves balance and was found to be a better index of intoxication. Time of nystagmus after rotation has not been investigated at SCRI as a measure; it is not a technique which can be readily adapted to field use.

The Finnish and SCRI investigators are in general agreement as to the merit of nystagmus, balance and walking tests. In regard to nystagmus Pentillä, et al., state:

> "When the blood alcohol level was lower than 1.26 or 1.51 ‰ the correlation coefficients of the nystagmus tests were highly significant..." (p. 22)
>
> "In cases with blood alcohol lower than 1.26 or 1.51 ‰ the nystagmus tests proved to be the only adequate tests on the basis of the results of several regression analyses." (p. 29)
>
> "...the nystagmus tests were the most valuable and objective tests on various blood alcohol levels..." (p. 38)

> “The nystagmus tests proved more valuable than other tests on lower (<1.26 or <1.51 ‰) blood alcohol levels.” (p. 39)

As discussed previously, SCRI also found nystagmus to be the best single index of intoxication. It is particularly valuable because it is an involuntary response. Police officers can readily learn to observe and evaluate the jerking movement. A simple device can be used to control the extent of eye deviation precisely, but the phenomenon also can be induced and observed in any environment without special equipment. SCRI data show a substantially larger BAC-nystagmus correlation than reported in the data from Finland. It is believed that this reflects procedural differences. The manner of conducting the test is described in the Finnish report as follows:

> “The subject was asked to fix his eyes on a small object 40 cm in front of his face and to follow the object with his eyes. The object was moved horizontally from one end of the sight field to the other one and backwards. The examiner fixed the head of the subject in normal position so that only the eyes were moving. The test was repeated three times.” (p. 53)

The SCRI procedure provided more precise control of the eye movement. The apparatus which was utilized was designed to control head position, head movement, rate of eye movement and angle of visual gaze. Examiners were instructed as follows:

> Move the light slowly to 30°. Hold at that position to determine if eye is jerking. Move the light to 40° and take second observation.
>
> Check: Head centered in chin rest.
> One eye covered.
> Continuous following with other eye.

The Finnish tests Walking-along-a-line and Gait-in-turning are together roughly equivalent in skill demands to the single SCRI test, Walk and Turn. Equivalent correlation coefficients were obtained (Table 7).

Also, the Romberg with eyes open and the One-Leg Stand tap similar balance skills, though the latter is considerably more difficult. Finger-finger and Finger-to-Nose have obvious similarities; in both data sets the correlations are smaller than for balance, walking and nystagmus.

Pentillä, et al., also report:

> "There was a considerable variation in the mean degree of error between various clinical tests on the same blood alcohol levels. There was also a wide individual variation in the performance results of clinical tests." (p. 18)
>
> "There were numerous slightly unstable or slightly incorrect performances in the walking a line test, Romberg's test with the eyes closed and the finger-finger test on lower blood alcohol levels." (p. 21)
>
> "If these total point values are compared with the respective total point values of the tests based on subjective estimation (quality of speech or behavior, relaxation of inhibitions and pulling oneself together) the negligible importance of these tests in the models is obvious." (p. 31)
>
> "The walking along the line and Romberg's tests were also included in the various adequate and optimal models." (p. 38)

The SCRI data are in agreement with all of the foregoing. It appears that the overall findings from the two studies are essentially the same. The differences which do exist appear to be attributable largely to procedural and population differences. In summary, both sets of data identify nystagmus as the best index of alcohol impairment, and both develop optimal batteries which include walking and balance tests.

IV. DRIVING TEST

The point of pdf 57 is to prove that SCRI's SPS driving simulator is alcohol sensitive. This page does not discuss the FST.

An additional objective of the project was the examination of the relationship between the effects of alcohol on the performance of the test battery and the effects of alcohol on driving skills. Selection of a valid driver performance measure is a difficult problem which is further complicated by the conditions of this application. Even a simplified representation of driving demands requires a relatively complex apparatus and task, and the performance by participants who have had no training reflects the influence of novelty and learning variables as well as BAC.

The SCRI Stimulus Programming System (SPS) was utilized as an analogue of driving. This apparatus is described in detail in Appendix 9. The display unit consists of a visual arc with a tracking display located in the central field and 40 LED numeral lamps evenly spaced from 15° to 100° in the right and left visual fields. For this study the system was configured as the simplest form of a driving simulator, requiring the division of attention which is characteristic of driving; that is, performance of a tracking task together with search-and-recognition for visual targets. Because it was desirable to minimize the learning requirement, the two components of driving were simplified as:

(1) Pursuit tracking with a pure gain controlled element,

and (2) near-peripheral signal detection task.

The tracking display was a 5" oscilloscope screen located 30" from the subject's eyes. The tracking cursors were two horizontally moving dots which the subject controlled by movement of a displacement fingertip stick.

The signal detection task used LED lamps located at 10°, 15°, and 20° right and left and 5° and 10° above and below the central line of sight for a 6 x 4 array of numbers. The target number 2 appeared at a different position on each trial in random order with changes occurring on the average every 5 secs. Response to the target was made by moving a 4-position switch to indicate the quadrant in which the target appeared. If the target was not detected, the display changed after 28 sec.

The following measures were obtained and automatically printed for 10 mins. of tracking with 21 targets:

1. RMS error integrated over time for the tracking task.
2. Latency of response to target LEDs.
3. Response errors (false alarms and false negatives).

A. Procedure

Participants equally representing the groups tested by each officer-examiner were selected at random within the constraints of the schedule of the sobriety test battery. A sample of 97 participants was tested immediately following the completion of the sobriety test battery. No training was given since the objectives include possible adaptation of the technique for impairment test purposes under circumstances of one-time testing.

B. Results

Appendix 9 gives a summary of SPS data and sobriety test data for the subset of validation study participants who also were tested on the SPS.

In examining the SPS data, it appeared that a performance trade-off between different components of the task occurred with considerable frequency. That is, under demands for division of attention when processing capacity had to be allocated across multiple task components, the individual's performance was maintained on one task while on the other impairment became apparent. Consequently, a single score, for example the tracking measure, may not adequately represent the total performance. To deal with this characteristic of the data, an additional index of performance was created by calculating Z scores for each measure and using the sum of the Z scores as a single measure of total performance.

Table 8 shows the t statistic for the various measures. These are interpreted as demonstrating the SPS task to be alcohol sensitive and also as lending support to a performance tradeoff between the two major task components. When the three measures, E^2, RT, and number of errors, are combined as Z scores, there is a significant difference between the two BAC groups. However, the tracking measure taken singly does not reflect significant impairment at the higher BACs (non-sig. t) whereas RT does. These results would be expected if the individual is attending primarily to the tracking task and taking the alcohol-related performance loss on response time to the LED targets. This interpretation must be viewed as tentative pending further study.

It should be pointed that distribution of attention is highly subject to factors which influence the person's perception of task priorities, e.g., task instructions. In this case, instructions placed equivalent emphasis on both parts of the task, but the participants apparently viewed the tracking task as being of first importance. It is a continuous central vision task which demands ongoing attention as opposed to the intermittent demands of the peripheral targets. This task structure, of course, parallels the attention demands of driving.

Table 8
t Tests for SPS Data

Participants ≥.10% BAC vs Participants <.10% BAC

Measure	t	ρ
Tracking E^2	1.61	.118
Reaction Time to LED Targets	3.27	.002
Number of Errors	1.51	.143
Σz Scores(Tracking, RT, Errors)	3.13	.003

It has been demonstrated that the SPS task is sensitive to the impairing effects of alcohol, but the primary issue here concerns the relationship of performance on this simple form of a driving simulator and performance of the impairment test. Does the person who shows impairment on the behavioral tests also show impaired driving skills? The analysis focuses on the three tests which are proposed as the final form of a sobriety test battery, i.e., One-Leg Stand, Walk and Turn, and Nystagmus.

The bivariate correlations between the SPS measures and behavioral test data are of interest, but as can be seen in Table 9, the nature and extent of the relationship is obscured by the necessity for interpreting nine correlations simultaneously.

This difficulty is avoided by the canonical correlation method which expresses the relationship as the maximum correlation between linear functions of the two data sets, subject to restrictions of orthogonality. The analysis obtains two linear combinations, one of the impairment test scores and one of the SPS scores; the coefficients for these linear combinations are those vectors which make the Pearson product-moment correlation as large as possible. Canonical correlation answers the question as to what extent individuals maintained the same level of performance on the two tasks.

The canonical correlation analysis was performed with computer program BMDP6M. Figure 12 is the computer graph of the first canonical correlation value of .576. "CNVRS1" on the ordinate represents the three sobriety tests, and "CNVRF1" on the abscissa represents the three SPS measures. (Note that the analysis continues to locate additional functions that correlate, but CNVR2 and CNVR3 are trivial.) This correlation means that the linear combination of the sobriety test scores accounts for 33% of the total variation in the linear combination of the SPS scores.

The source of the relationship can be examined by means of the coefficients for computing the canonical variates:

.802 Tracking + .024 RT + .498 Errors,

and

.522 One-Leg Stand + .616 Walk and Turn + .035 Nystagmus.

The relationship is primarily between tracking (SPS) and balance and walking (Sobriety test battery). This finding is not surprising; since the impairment tests include no perceptual tasks, it is only with the psychomotor component of the driving test that a correlation can appear.

Table 9
Correlations: Impairment Tests Scores and SPS Data

	SPS Data		
	Tracking E^Z	Reaction Time	Errors
One-Leg Stand	.420	.150	.280
Walk and Turn	.436	.123	.316
Total Nystagmus	.314	.268	.137

18% 0.420	2% 0.150	8% 0.280
18% 0.430	2% 0.123	10% 0.316
10% 0.314	7% 0.268	2% 0.137

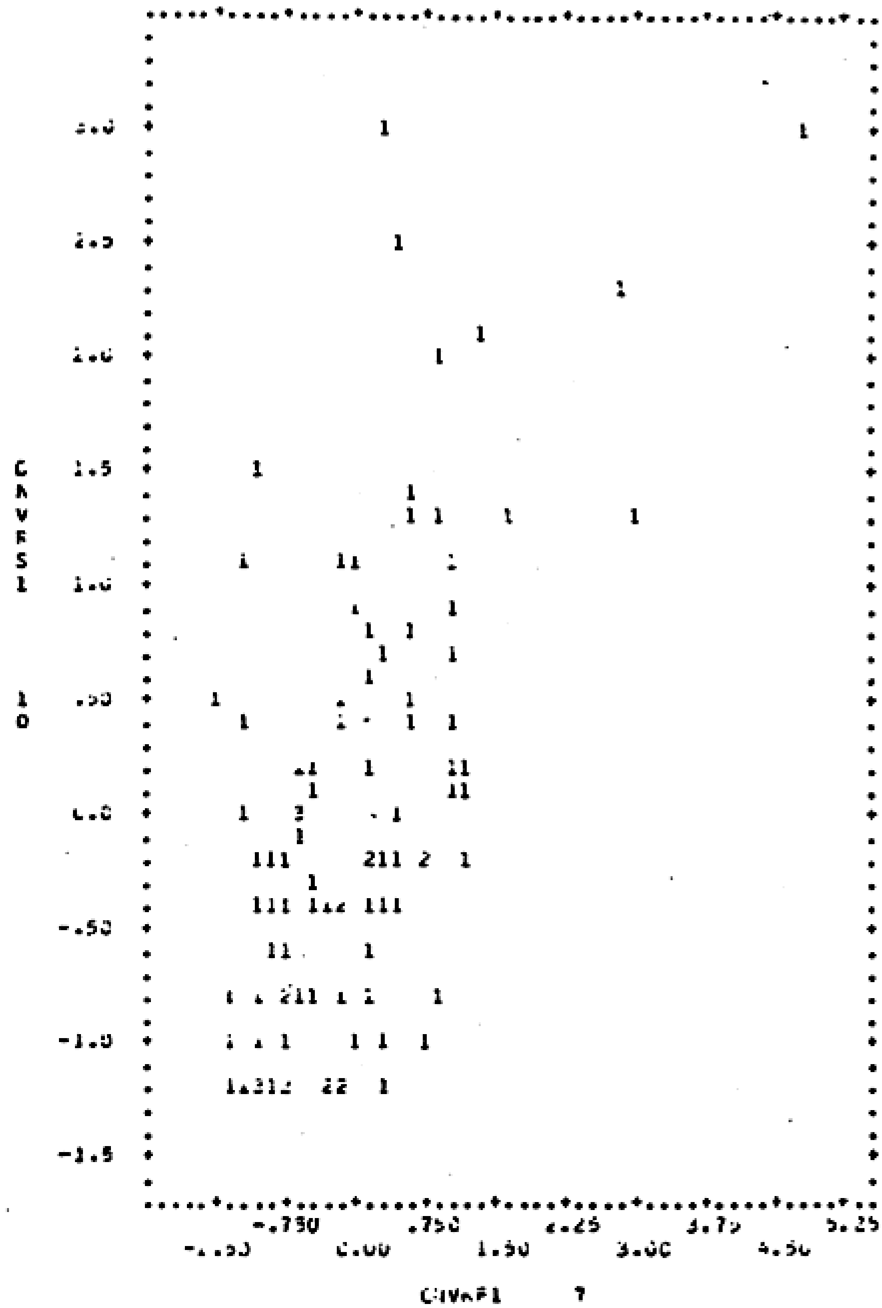


FIGURE 12: Computer Graph of Canonical Correlation (DWI Battery and Driving Test Scores)

In summary, for these participants there was a significant relationship between the driving task and the test battery. Further investigation of the divided attention task as utilized here with the SPS is suggested. It is possible that the task can be further adapted and simplified hardware developed so that it will have utility as a test of impairment to be used in the setting of the police station or a van.

V. SUMMARY AND CONCLUSIONS

The study objectives which were set forth in the work statement have been achieved as follows:

> 1. Evaluate currently used tests to determine their relationship to intoxication and driving impairment.

Examination of the sobriety test literature, and observations of tests of impairment as performed by police officers indicate that currently the same tests are used in most locales. Administration and evaluation procedures vary widely, but the tests usually include some version of walking the line, touching the finger to the nose, picking up small objects, and body sway or balance. All of these tests have been evaluated in the laboratory during this study.

> 2. Develop more sensitive tests to provide better evidence of impairment and to have a closer relationship to driving impairment.

A number of potential techniques, as derived from a diverse literature, have been examined. However, the conditions of roadside testing impose stringent constraints which few tests can meet. The measure of Alcohol Gaze Nystagmus (AGN) was found to be a highly sensitive index of impairment which presently is under-utilized. The identification of AGN as a sensitive test is a major contribution from this study.

> 3. Standardize the tests and observation procedures.

It became apparent during field visits that this objective is highly important. There are wide differences between officers in using tests to assess a driver's state of intoxication, and they may exist within a department as well as between agencies and locales. These differences seriously detract from reliability as well as from the credibility of the officers in court proceedings.

Insofar as possible within the limitations of this study, test administration and scoring have been standardized. Instructions for use of each test are presented in the test manual together with performance criteria for scoring on a 1-10 scale.

The choice of tests for a recommended battery is based on the study findings and additionally on the assumption that a DWI suspect will be examined at roadside where conditions vary widely and where no test hardware is likely to be available.

At the present time, roadside testing is practiced extensively, but there are other DWI systems in use, as well as potential systems, which merit consideration. Those which were observed during field visits include at one extreme some which use <u>no</u> behavioral tests. The driver is informally observed and interrogated at roadside, and if the officer believes the BAC to be higher than .10%, the DWI suspect is transported directly to the station for breath testing.

In one locale where observations were made, a Metro-DWI program is jointly sponsored by the city police and the sheriff's department. They utilize a camper mounted on a pickup truck to transport an Intoximeter (gas chromatograph) to any location within the jurisdiction where an alcohol-involved driver has been detained. Two such vehicles are on the street during night hours, one during the day, available for call by any patrol unit. The officer who drives the vehicle administers the breath test. If the BAC reading is found to be .10% or above, the driver then is arrested and transported by the officer who originally made the stop. No behavioral tests are administered.

Two cities were visited where tests of impairment are first given at roadside and then repeated at the station for purposes of videotaping. Some disadvantages with this system are apparent. It lengthens the procedures which in most cases already are viewed by the officers as too costly in terms of demands on their time. Also, the videotape which is intended to be used as court evidence is likely to show less impairment than was observed at roadside; time has elapsed and the BAC may have declined. The person has had a chance to pull himself together and also has in effect "practiced" the tests at roadside. Unless BAC is very high, the videotaped performance of sobriety tests may not reveal any impairment at all.

A highly effective DWI system was observed in Denver, Colorado, where the police department fields special DWI patrol units, two officers per car. In addition to their own DWI detection activities, these units are radio-summoned by regular patrol officers to handle alcohol-involved drivers. This is an important aspect of the system since it alleviates officers' reluctance to become involved with time-consuming DWI arrests at the expense of other activities, and thus significantly increases the level of surveillance.

It also is highly important in the Denver system that turnaround time (from detection through arrest and booking processes back to the street) has been reduced to a reasonable minimum. No testing is performed at roadside. The DWI suspect is transported immediately and the reading of rights and chemical-test consent or refusal are accomplished enroute. The behavioral tests are administered and videotaped in the station in a highly standardized format. The tapes which are obtained provide court evidence which is consistent in quality and content.

An additional feasible system might utilize a van or motorhome to go to the location where a DWI suspect is detained. Such a vehicle could accommodate (1) gas chromatograph, (2) videotape equipment, and (3) space and equipment for behavioral tests. In this case, as with testing at the station, there is the considerable advantage of having the same environment for every case and also the potential for using equipment which cannot be made available at roadside. For example, with some additional effort the divided-attention task which was presented during this study with the SCRI Stimulus Programming System probably could be adapted to become an important component of testing for alcohol impairment.

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APPENDIX 1
LITERATURE REVIEW

The literature of three general areas was searched: (1) alcohol effects, (2) alcohol and driving, and (3) sobriety tests and procedures. In addition, a diverse literature relating to various stressors other than alcohol was examined. Overall, the materials with a direct bearing on project objectives were found to be relatively sparse. The following review is limited to those which have specific relevance to test selection, or administration and scoring procedures.

Alcohol Effects:

There is, of course, a very large literature on the effects of alcohol on performance. It is reviewed here only to the extent that a direct contribution was made to this project.

Jellinek and McFarland (1940) produced a comprehensive review of behavioral changes under alcohol. Tests which emerge from the review as potential candidates for a sobriety test battery, falling within the constraints of time, environment, and apparatus, include the following: letter cancellation, 2-point tactile discrimination, color perception and grip strength. Jellinek and McFarland report experiments in which these measures were demonstrated to be alcohol sensitive.

The reviewers conclude that the experimental evidence indicates that simple psychological variables are less affected by alcohol than complex ones, that in any sensory modality discrimination is much more impaired than acuity, and that the main effect is cortical rather than peripheral.

Goldberg (1943) performed a series of laboratory studies to investigate the following:

- the effect of alcohol on sensory functions (fusion frequency of eye, corneal sensitivity)
- the effect of alcohol on motor functions (Romberg, finger-finger test)
- the effect of alcohol on psychological functions (subtraction and letter cancellation)
- the influence of food on alcohol tolerance
- the influence of habituation on alcohol tolerance

The entire test battery as utilized by Goldberg required 25-40 minutes, as well as considerable experimental apparatus. However, adaptations of the Romberg and finger-finger tests currently are widely used by police officers, both in the field and in the station, and the subtraction test and the cancellation test are tentative candidates for a sobriety test battery.

The conditions which Goldberg enumerates as necessary for the purpose of following the influence of alcohol on a function also are essential for DWI test purposes and merit repetition hers, as follows:

> "1. The criteria of the alcohol effect as tested by the method should be constant, and should preferably leave no room for subjective judgment, if this factor cannot be ruled out, the method must permit of measuring its magnitude and bearing upon the results.
>
> 2. The variability of the method must be slight as compared to the changes which occur during alcohol ingestion.
>
> 3. If the test is to be applied for practical purposes, and no basal values are available, the variability between individuals should be slight as compared with the departures from normal due to alcohol.
>
> 4. The method must be 'sensitive' in order to react on slight degrees of intoxication. The word 'sensitive' can be interpreted in four different manners at least, as far as methods are concerned to reveal alcohol intoxication:
>
>   a) A slight variability under normal conditions.
>
>   b) Significant departures from normal at low alcohol concentrations, which correspond to a low appearance threshold.
>
>   c) A steep slope of the line of regression between log symptoms and blood alcohol, indicating a regularly increasing degree of intoxication with slight changes in blood alcohol.
>
>   d) A slight variability after alcohol intoxication in relation to the slope of the regression line, giving highly significant departures from normal already at low degrees of intoxication." (p.76)

In comments on the appropriateness of the methods is tests for intoxication, Goldberg interprets the data as showing test sensory functions were influenced at the lowest and psychological functions at the highest BAC. Motor functions (in particular, as measured by the Romberg) showed the largest departure from normal and are claimed to be useful even when a performance baseline is unknown since the alcohol effects greatly exceed between individual variation. The investigator also concludes that flicker frequency, corneal sensitivity and subtraction are not suitable absolute tests of intoxication.

Numerous studies have investigated acute alcohol tolerance, but findings have been confounded by procedural problems centering on measurement of BAC (Harger, 1963; Begg, Hill and Nickolls, 1963) and failure to control for practice effects (Eggleton, 1941; Alha, 1951). However, in experiments which controlled these variables, Hurst and Bagley (1972) and Moskowitz, Daily and Henderson (1974) found that acute tolerance does develop and that impairment is less at a given BAC on the falling than on the rising curve. Note that the impairment differential is quite small.

Colguhoun and Edwards (1975) report a study of the interaction of noise with alcohol on a task of sustained attention. They interpret the data as supporting the view that noise is an arouser and alcohol is a cortical depressant.

Alcohol Effects on Driving:

The extant literature specific to alcohol effects on driving skills has been comprehensively reviewed elsewhere (Carpenter, 1962; Wallgren and Barry, 1970; Moskowitz, 1973). These reviews, as well as recent reports of laboratory data, appear to be virtually unanimous in converging on an information processing model of driver impairment by alcohol. Moskowitz in his 1973 review concluded that "...drivers under the influence of alcohol have their information processing capacity reduced and thus must restrict some of their information inputs which might normally have been processed concurrently." (pp. 196-197).

Stressors Other Than Alcohol:

Methods which aid in the assessment of impaired functioning, whatever the source of the behavioral deficit, may have possible utility in a test battery. From this point of view a diverse literature was searched in an effort to locate either innovative techniques or more standard evaluative procedures which have not previously been utilized in alcohol enforcement.

Nathanson and Bergman (1958) reviewed medical procedures for evaluating patients with altered states of consciousness. They describe a face-hand test which potentially might be adapted for sobriety testing.

Parker, et al. (1963), performed a study for NASA to develop tests intended primarily for assessing the effects of weightlessness and other space environment characteristics on human performance. The project objectives were defined as the development of a small battery of tests to measure the primary dimensions of perceptual-motor performance. The following factors were selected as representing ability dimensions for which performance tests should be developed:

1. Fine manipulative abilities
    - arm-hand steadiness
    - wrist-finger speed
    - finger dexterity
    - manual dexterity
2. Gross positioning and movement abilities
    - position estimation
    - response orientation
    - control precision
    - speed of arm movement
    - multilimb coordination
    - position reproduction
3. System equalization abilities
    - movement analysis
    - movement prediction
    - rate control
    - acceleration control
4. Perceptual-cognitive abilities
    - perceptual speed
    - time sharing
5. Reaction time ability
6. Mirror tracing ability

An integrated instrument console was developed to present tests of these 18 perceptual-motor abilities. Administration time was approximately 90 minutes. Only preliminary data are reported, for which it is stated that subjects showed wide individual differences on all task skills. As demonstrated by these investigators, variability is a main source of difficulty for sobriety tests.

The effects of Librium, meprobamate, alcohol, and altitude were examined by Pearson and Neal (1970). The experimental tasks included a tracking and monitoring task, choice reaction time, auditory vigilance and the welford serial performance, problem-solving apparatus. In general, no decremental effect of alcohol and drugs on performance of these tasks occurred. The investigators attribute the negative findings to the mitigating factors of task load, feedback and subject set.

The utility of four psychomotor tests in diagnosing cerebral lesions was examined by Dee and Van Allen (1972). The tests were grip strength, tapping rate, simple auditory reaction time and simple visual reaction time. It was concluded that performance of these tests, when assessed quantitatively, might aid in the detection of cerebral disease. However, the actual utility would be contingent on determining performance base rates for brain-damaged and nonbrain-damaged as a function of sex and age.

Fregly, et al., (1972) standardized the procedures for testing a person's ability to walk on the floor with eyes closed (WOFEC). The test, which has been used as a qualitative clinical test of ataxia, is recommended as a subtest in a quantitative test battery. However, the investigators caution that its validity is dependent upon strict adherence to rigid, standardized test procedures.

These preceding three studies serve to illustrate the source of some difficulties with sobriety tests. Even for data collected within the controlled environments of laboratories, the investigators cite the influence on performance of the variables of subject set, sex, age, and rigid, standardized test procedures.

A study designed to vary attention demands presented brief tones at irregular intervals which were counted by subjects while they performed the Romberg test. Njcobiktjen (1973) designed the task to raise the general attention level and divert attention from standing. Healthy subjects tended to reduce postural sway under the loading of the auditory task. Neurological patients behaved differently according to the particular disorder. Subjects described as having "severe central processes" were found to sway more when the two tasks were combined.

McFarland (1973) exposed subjects to low levels of carbon monoxide and then tested their ability to perform driving-related laboratory tasks, as well as on-the-road driving. The laboratory tests included: (1) complex psychomotor reactions including simultaneous performance of both a primary and secondary task, (2) dark adaptation and glare recovery, (3) peripheral vision, and (4) depth perception. All of the tasks require laboratory apparatus. The overall pattern of results indicated no serious impairment of driving abilities by carbon monoxide.

A standardized battery, of performance tests was developed by Theologus, et al., (1973) for use in assessing the effects of noise stress on human performance. A Perceptual-Motor Performance Console (PEMCON) was utilized to present three tasks: a reaction time task, a rate control task, and a divided-attention task (performance of the RT and rate control task simultaneously). The data on the effects of noise are complicated by the differences between patterned and randomly intermittent noise and by the time course of noise effects. It is pertinent here to note that the investigators stress the importance of standardizing procedures and conventions for administering and scoring tests.

Note that although these laboratory studies of performance are of general interest, they are not feasible for roadside use. Possibly instrumentation could be developed if a test battery were to be designed solely for use in a police station or van.

Sobriety Tests and Procedures:

A highly important study of sobriety tests was carried out in Finland. From the United States the DWI Law Enforcement Training Project materials, prepared under contract DOT-HS-334-3-645 (Carnahan, et al., 1974) present comprehensive and accurate information for training purposes. Driving Under the Influence of Alcohol or Drugs, as prepared by the Traffic Institute, Northwestern University has somewhat less merit. State and local agencies provide driver handbooks and materials for officers on DWI patrol which contain useful, general information about alcohol effects and the DWI suspect. However, the Finnish study is the most comprehensive and rigorous investigation.

Sobriety testing is of major importance in Finland where there is no statutory blood alcohol limit. Clinical examinations for intoxication are performed by physicians, and courts mete out sentences of considerable severity for driving while under the influence of alcohol. License suspension is usual and imprisonment is not uncommon. Understandably the examination procedures, including the psychophysical tests, have come under close scrutiny. Pentillä. Tenhu and Kataja (1971) have performed extensive analyses of data from the clinical examinations by physicians, and their reports represent the most systematic and thorough study of sobriety tests to be found in the literature.

In an initial study they analyzed the records from 6,839 clinical examinations for intoxication which were performed at the Department of Forensic Medicine, University of Helsinki during the years 1965-1969. The test battery included the following: walking tests, gait in turning, Romberg tests, finger to finger test, match test, speech and behavior, counting backwards, and orientation to time and place. They found significant correlations for all tests with blood alcohol level, but there was a substantial overdiagnosis of intoxication due principally to incorrect and unreliable performance of the tests at low blood alcohol content (BAC). The investigators recommend that procedures be improved by "...carefully defining what constitutes a state of intoxication on the basis of all the clinical tests and observations." (p. 40)

A second study by the same Finnish investigators (1974) utilized the data from 495 clinical examinations in an effort to configure an optimal test battery. The tests varied slightly from those previously listed, the most important change being the inclusion of three measures of nystagmus. The most pertinent conclusion is that a reliable test battery which correlates significantly with BAC can be developed and that it hinges largely on specification of exact test procedures, performance criteria, and quantified assessment methods.

The nystagmus measures were found to be the most valuable indices of intoxication with the other tests in decreasing order of value as follows: walking along a line, walking test with eyes closed, Romberg's test with eyes open, collecting small objects test, counting backwards test, orientations as to time, finger-finger test, and gait in turning. Tests which were based solely on the physicians' estimate of intoxication were found to be of no value.

The reported results with regard to nystagmus, the involuntary jerking movements of the eyes, are of particular interest as a potential measure for sobriety tests. There are several kinds of nystagmus: note that these investigators are reporting on Alcohol Gaze Nystagmus (AGN) and on nystagmus induced by rotation, described in the report as follows:

> "The subject was asked to fix his eyes on a small object 40 cm in front of his face and to follow the object with his eyes. The object was moved horizontally from one end of the sight field to the other one and backwards. The examiner fixed the head of the subject in normal position so that only the eyes were moving. The test was repeated three times.
>
> The subject was rotated horizontally on chair 5 times during ten seconds. After rotating the subject was asked to fix his eyes on the small object 40 cm in front of him. The time of oscillatory movements of the eyeballs (i.e., nystagmus) was taken with an accuracy of one second by using a stop watch." (p.53)

AGN appears as a jerking in the direction of gaze when the eyes are laterally deviated 30-40°. It increases in intensity with increasingly eccentric fixation of the eyes, and appears much more distinctly when fixation is monocular rather than binocular. It appears at a BAC as low as .06% and typically it is quite distinct at .10% BAC.

Aschan (1958) studied both positional alcohol nystagmus (PAN) and alcohol gaze nystagmus (AGN). The former requires nystagmographic recording and therefore cannot be readily adapted to the typical circumstances of sobriety testing. AGN can be observed easily without special instrumentation.

Aschan points out that ". . . AGN resembles other manifestations of alcohol intoxication related to a critical threshold value. . . from the fusion frequency of the eye, corneal reflexes, and a quantitative Romberg's test to disturbed visual attention. . . which have been studied by Goldberg (1943)."

Goldberg (1943) also reports on both PAN and AGN as studied in a series of experiments with a total of 260 subjects. He concluded that AGN is the one most easily observed, appearing when BAC exceeds 60-70mg/100ml and disappearing when BAC falls below that level. He suggests that nystagmus may have value for clinical examinations but requires study with persons with varying alcohol consumption practices.

There are a number of other studies of optokinetic nystagmus (Blomberg and Wassen, 1962; Honrubia et al., 1968; Mizoi et al. 1969), vestibular nystagmus (Schroeder, 1971, Schroeder et al., 1973; Oostervelo and van der Learse, 1969; Collins 1963), and positional nystagmus (Fregly, 1967; Oosterveld, 1970) These serve to elucidate the mechanisms of nystagmus and the role of such variables as alcohol, gravity, and acceleration. However, the time-and-equipment limits imposed by sobriety testing render measurements of these forms of nystagmus impractical for the purposes at hand.

APPENDIX 2
Field Visits to Observe
Police Officers Administering Sobriety Tests

Interviews and observations of law enforcement officers were undertaken as an initial project effort in order to assess current sobriety-testing practices. Field visits were made to eight locations, as detailed below, where the project director engaged police officers in informal interviews and rode with a patrol unit for one night-time work shift. Assessment objectives of these visits included the following:

Interviews:

Attitudes of officers toward alcohol enforcement.

Officers' knowledge of alcohol effects and DWI role in traffic accident statistics.

Officers' knowledge of psychophysical tests, procedures, and evaluation.

Observations:

Environmental conditions of interrogation and testing.

Tests (which tests, how administered, how scored, face validity, reliability).

Total DWI-arrest procedure (detect, apprehend, test, arrest, transport, book).

Total DWI system (specialized units, deployment of vehicles, roadside vs. station testing and video-taping, level of alcohol enforcement effort).

Influence on test administration of sex, age, ethnic group, and economic status.

The following were visited:

1. Los Angeles County Sheriff 's - ASAP Unit
   City of Industry, California
2. Seattle DWI Squad
   Seattle, Washington
3. California Highway Patrol
   West Los Angeles, California
4. Chicago Police Department
   Chicago, Illinois
5. Denver DWI Unit
   Denver, Colorado

6. Memphis Metro DWI Unit
   Memphis, Tennessee
7. Texas Highway Patrol
   Denton, Texas
8. Santa Monica City Police
   Santa Monica, California

The following tests have been observed in use:

Walk the line, heel-toe

One-Leg stand

Romberg

Finger-to-nose

Finger count

Tongue twisters

Recite alphabet

Pick up coins

Nystagmus

The level of alcohol enforcement varies between agencies and locales and ranges from an extremely low-priority effort to intensive attacks on the DWI problem by specialized units. In a typical system the detection and arrest of intoxicated drivers is the responsibility of regular patrol units, and the decision as to priorities rests within the division, possibly with a lieutenant or sergeant who must allocate available manpower.

There are also marked differences in the reliance on behavioral tests. In some areas no tests are administered either at roadside or in the station. The chemical test together with the officer's report (observation of vehicle, interrogation and observation of driver) suffice as court evidence. In one metropolitan area the gas chromatograph is taken to the scene of a vehicle stop or to an accident and the breath analysis determines whether there is alcohol involvement.

In other locations tests are used and behavioral test evidence is required by the courts, either as videotapes or from the officer's report and testimony, but the officers make an arbitrary, case-by-case selection of tests. Also, the same test may be administered with different instructions and procedures by different officers. Finally, there also are departments which require routine, standardized administration of an established battery to every DWI suspect.

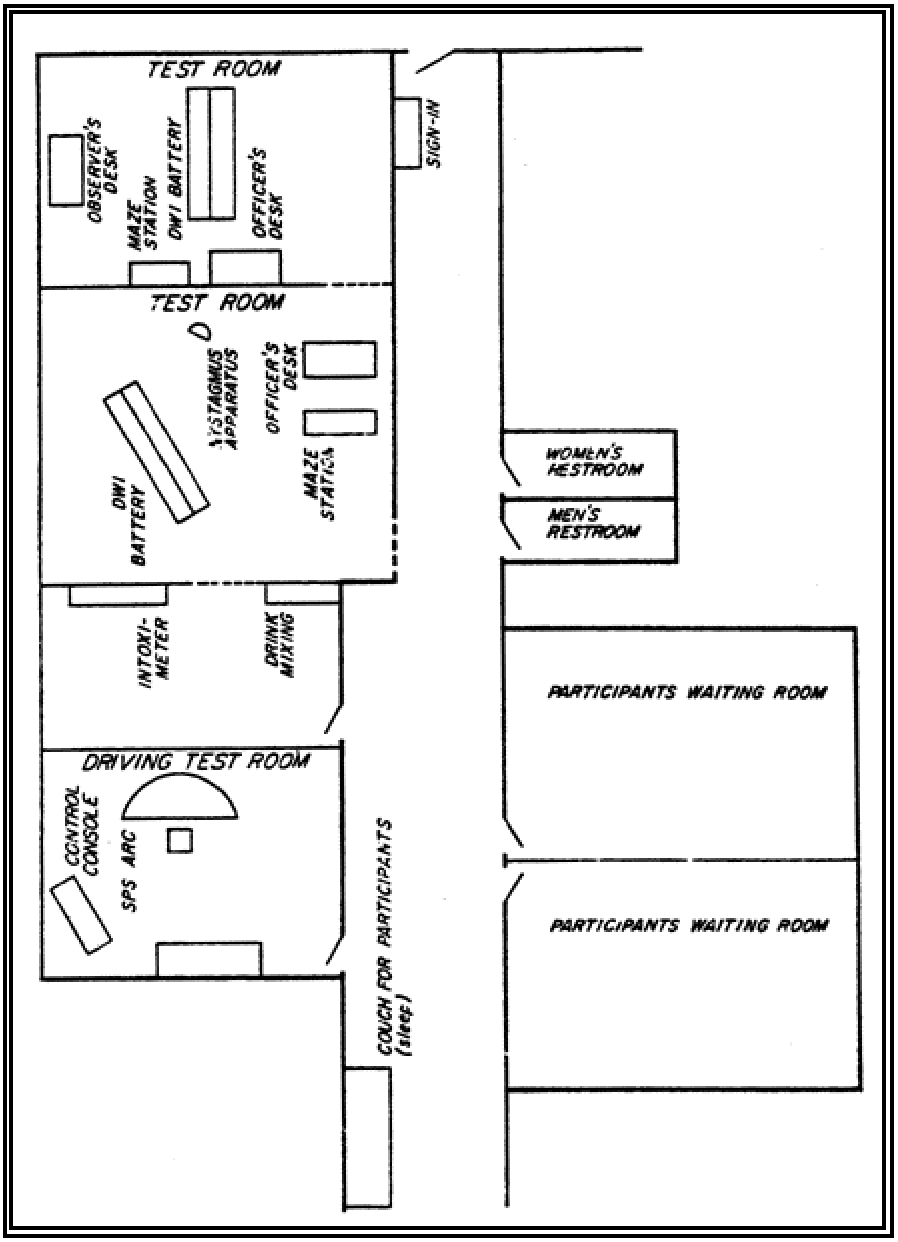
Videotapes are utilized effectively by departments where skilled officers rigidly adhere to standardized testing procedures. High quality tapes can be obtained at roadside, as well as in the station, and are considered a valuable adjunct to the officer's testimony in court proceedings.

Balance and walking tests are the most widely used tests of impairment. In addition, officers rely on cues of odor, speech and appearance as routinely noted during initial questioning. It also is common practice to inspect the subject's eyes for unusual dilation or redness.

APPENDIX 3
Criteria for Test Selection
for Impairment Test Battery

1. Test results are quantifiable.
2. Test variance is small relative to the alcohol effect. Individual differences in performance are not expected to obscure alcohol effects.
3. Test is sensitive to alcohol effects at .05% BAC and higher.
4. Scores from the test battery correlate with BAC in the range .05-.30%
5. Test is short and easily administered.
6. Standardized administration and scoring methods can be learned readily by officers.
7. Tests to be administered at roadside require no hardware.
8. The test battery examines for a range of abilities, including alcohol impairment of motor, cognitive and divided attention skills, as well as involuntary responses.
9. Use of the roadside test battery will substantially improve officers' ability to evaluate an individual's level of impairment, as compared to evaluations which are not based on test results.
10. Test is expected to be credible and acceptable to DWI suspect, law enforcement personnel, and the judiciary.
11. Alternate test is available if individual cannot perform task due to some characteristic other than impairment by alcohol.

APPENDIX 4
LABORATORY LAYOUT



APPENDIX 5
Test Protocol and Score Sheet

Test Battery Instructions and Procedures

In order to obtain valid results from the DWI test battery, it is necessary to conduct the testing with standardized instructions and procedures. All persons tested must be given the same opportunity to understand how the test is to be performed.

Circumstances in the field or station will vary widely, but every effort should be made to adhere closely to the basic instructions as outlined in this manual. Exact wording is not mandatory, but deviations should be minimal.

Effective use of videotapes depends on camera placement and on test procedures which make poor performance clearly visible. The examiner's correct demonstration of the task will serve as a criterion performance for the viewer. Both video and audio should clearly emphasize the nature of errors which require a trial to be interrupted. The viewer may not have observed the failure, for example, to touch heel to toe or the improper use of arms for balance. Camera angle, lighting, and background contrast also can facilitate quality videotapes.

1. One-Leg Stand

Position person facing camera and examiner.

> Watch what I do but don't begin until I tell you. Stand with your feet together, arms at your side, and hold one leg straight and forward like this. (Demonstrate with foot held 8-12" off the floor.) Do you understand? Ready? Begin. Don't put your foot down until I tell you.

Trial length: 30 seconds.

Check: Feet together
Arms at side
Leg straight.

If position is incorrect, interrupt trial and repeat demonstration. Give second trial or discontinue.

2. Finger-to-Nose

Position person facing camera and examiner (back to wall stripes).

Watch what I do so you will be able to do the same thing. Don't begin until I tell you. Stand with your feet together and hold your arms out like this (demonstrate arms fully extended level with shoulders). I want you to close your eyes and when I say "Right," bring your right index finger to touch your nose, then return your arm. When I say "Left," touch your nose with your left index finger. (Demonstrate for right and left.) Do you understand? Ready?

Give a random sequence of five: e.g.,	R-L-L-R-L
	L-R-R-L-R

Check: Eyes closed

Arms fully extended

Arms at shoulder height

Nose touched only with index finger

Arms returned to position after each trial

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

3. Finger Count

Face me and watch carefully what I do, but 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.) 1-2-3-4-5-5-4-3-2-1. Touchcount. Do you understand? O.K., you do it.

Check: Thumb-finger touched correctly

Correct count

Give repeat demonstration and second trial if first trial is incorrect.

4. Walk and Turn, Heel-Toe

The following instructions are for a test location where a line is marked on the floor. Under other circumstances adapt the same instructions. Line to be walked should be at slight angle to camera.

Again, watch what I do so you will be able to do it the same way. I want you to put one foot here on the line, and then take exactly 9 steps along the line, touching your heel to your toe each step (demonstrate). Then turn and take nine steps back along the line, touching heel-toe. Do you understand? Come here to the line and begin.

Check: Heel-toe position each step.

Trial should be interrupted if person fails to touch heel to toe. Also, if number of steps is incorrect, at end of trial ask person how many steps were taken each direction.

5. Tracing Mazes

Person to be tested should be seated at table. Place first maze on table and point appropriately while giving instructions.

Begin here with the pencil and trace between these lines. Try not to touch or cross the lines. Keep going around and around. Go as fast as you can, but don’t pick up your pencil and try not to touch the lines. You have three pages to trace. Do you understand? Ready? Begin.

Trial length: 20 seconds each maze.

6. Nystagmus

The following instructions are for use with the SCRI nystagmus apparatus. If that equipment is not available, adapt the procedure using pencil or finger movement and estimating the visual angles. Observation of the characteristic jerking at a gaze more extreme than 45° should not be relied upon as an index of intoxication.

Put your chin here in the chin rest. Cover your left eye and without turning your head, follow this light, using only your right eye. Don't move your head, and keep looking at the light. Now cover your right eye, and do the same thing.

Move the light slowly to 30°. Hold at that position to determine if eye is jerking. Move the light to 40° and take second observation.

Check: Head centered in chin rest

One eye covered

Continuous following with other eye

Alternate Test:

Romberg (Body Sway)

Position person to be tested at right angle to camera and examiner (in front of wall stripes, if available).

Watch what I do so you can do the same thing. Watch me, and don't begin until I tell you. Stand with your feet together, arms at your side. Tilt your head back and close your eyes. (Demonstrate.) Do you understand? You are to stay in that position until I tell you to stop. Ready? Begin.

Trial length: 45 seconds.

Check: Feet together

Arms at side

Head tilted back

Eyes closed

If position is incorrect, interrupt trial and repeat administration. Give second trial or discontinue.

Alternate Test:

Subtraction

I'm going to tell you a number. I want you to subtract 3 from it, then subtract 3 from that number, and keep going until I tell you to stop. For example, if I told you to start at 25, you would say 22, 19, 16, 13, etc. Do you understand? Start at 102 (or 101) and subtract 3. Keep going until I tell you to stop.

Trial length: Time to 60 (59).

If the subtraction task is too difficult for reasons other than intoxication, ask the person to count backwards. Adapt instructions for counting.

Alternate Test:

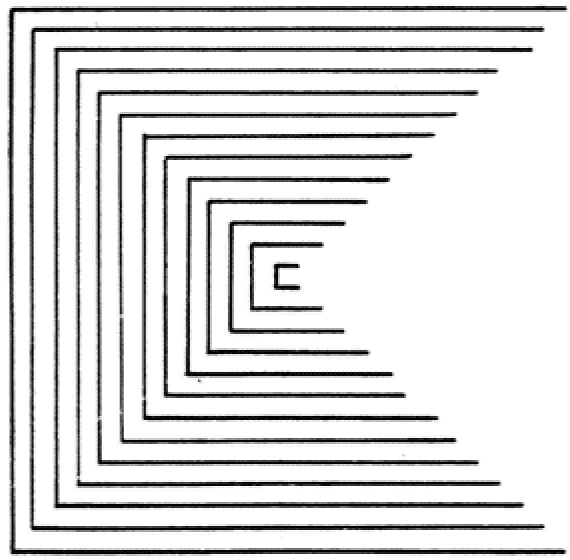
Letter Cancellation

Person to be tested should be seated at a table. Place the test page face down in front of the person.

On this sheet of paper there are several paragraphs of printed material. When I tell you to begin, I want you to turn the page over and go through the material line by line, canceling every letter "E". (Demonstrate by marking on back side of page ɇ.) Go as fast as you can without skipping any "E' s". Do you understand? Ready? Turn the page over. Begin.

Trial length : 30 seconds.

TRACING TEST



LETTER CANCELLATION TEST

RECONSTRUCTION OF POST ACCIDENT FORE-BATTERY OF DRIVING RELATED VISION TESTS SCHOOL BUS SEAT BACK PADS: THE CALIHEAD INJURY EVALUATION: CRITERIA FOR

wearing of seat belts compulsory in the province. And, for larger distribution, related print messages driving a car. Some 696 motorcyclists have been

He pointed out that even Nova Scotia had decided mats with varying complexity and completeness are pulsory because of a lack of citizen support and a provide information through many channels—mass The argument I've heard most often is that if I were from the Throne that it was considering making the printed material and folders; a community action derstandable way what happens in a collision, as law. Why? Because too many people were against it,

"It started three years ago as a love affair with a ed by the Ministry, showing in a dramatic and unregistrations went from 34,000 to 50,000, the number "But, like governments in all other nine provinces, it columnists in most Ontario newspapers have convince the unconvinced that seat belts can and do do prevent injuries and do save lives," the Minister

SCORING RECORD

Participant # __________ Sex ____________ Officer ______________________________

Date of birth___/___/___ Date_____

Approx. weight__________

QUESTIONS

Without looking, what time is it now?_____________ Actual time_______________

Have you been drinking? ___________ Are you under the influence of alcohol now?______

When did you last eat? _____________ What did you eat at that time?____________________

When did you last sleep? ____________________ How many hours? ___________

Do you have any physical defects? Yes ______ No______ If yes, describe:

Are you ill? Yes ____ No ____. Are you hurt? Yes _______ No _______. If yes, what is wrong? ____

Have you recently been to a doctor? Yes_____ No ____; a dentist? Yes ___ No ____

If yes, when? ____

Reason for seeing doctor or dentist____

Are you taking medicine? Yes ______ No __. If yes, what? _______________________

Last dose taken when? ________________ a.m.________ p.m._______

OBSERVATIONS

CLOTHES: Orderly ______ Mussed______ Soiled______ Disorderly___ Disarranged____

Describe____

BREATH (odor of alcoholic beverage): Strong _____ Moderate______ Faint______ None_______

ATTITUDE: Excited______ Hilarious______ Talkative______ Carefree______ Sleepy______

Combative______ Indifferent______ Insulting______ Cocky______ Cooperative___

Polite______ Other____

UNUSUAL ACTIONS: Hiccupping______ Belching______ Vomiting______ Fighting___

Profanity______ Other_____________________________________

SPEECH: Incoherent______ Mumbled ______ Slurred______ Confused______ Thick tongued___

Stuttered ______ Accented ______ Good ______ Fair ______ Other _________

COLOR OF FACE: Normal ______ Flushed ______ Pale______ Other_________

EYES: Normal ______ Watery ______ Bloodshot______

PUPILS : Normal ______ Dilated ______ Contracted ___ Slow reaction to light _______

1. One Leg Stand:

Preferred leg, 30 sec trial

No problem with balance	(0)	________
Slightly unsteady	(2)	________
Moderately unsteady	(4)	________
Extremely unsteady	(6)	________

Add 1 point for each of the following, if applicable:

Required repeat of demo/instruc.	________
Put foot down	________
Use of arms to keep balance	________

Falling/no attempt/discontinued (10) ________ Total ________

Comments: ____

____

2. Finger-to-Nose (5 Trials):

On 2 or more trials, touching nose was:

Sure, accurate	(0)	________
Slow but accurate	(2)	________
Uncertain, fumbling, but touches	(5)	________

Add 1 - 2 points, as applicable:

Requires repeat instruction/demo.	________
Does not return arm to starting position.	________
Uses entire hand instead of finger	________

OR

Misses completely (10) ________

Total ________

Comments: ____

____

3. Finger Count (1 trial each hand):

Check all applicable: (Maximum score =10)

No problem	(0)	________
Required repeated instruction, demo.	(2)	________
Confused, started over	(3)	________
Did not correctly touch thumb - finger	(5)	________
Counting errors	(5)	________
OR		
No attempt/discontinued/failed	(10)	________
	Total	________

Comments:____

____

---

4. Walk-and-Turn, Heel-Toe (9 steps, return):

No problem	(0)	______
Slow or minor problem	(1-4)	______

OR

Check below to describe unsteadiness:

(1-2 points each. Max. score = 10).

Loses balance, walking	________	
Loses balance, turning	________	
Cannot stay on line	________	
Extreme use of arms and/or body to maintain balance	________	
Does not touch heel-toe	________	
Incorrect no. of steps	________	
Stops to steady self	________	
Requires repeat of demo	________	—OR—

4. Walk-and-Turn, Heel-Toe (9 steps, return): CONT

Falling/will not attempt/discontinues (10) ______

Total ______

Comments:____

____

5. Tracing (3 trials, 20 sec. each):

Score: 5 points each completed loop minus 1 point each cross-over or touching of line. Loop is scored if tracing is past top center.)

Points for Maze 1 _____	Points for Maze 2 _____	Points for Maze 3 ____	Total Points _____

(÷ 3 = average)———

Points	Average Earned Score
over 20	0
16 - 20	2
10 - 19	5
less than 10	10

Score ______

6. Nystagmus:

(Max. score = 10 each eye)		LEFT EYE 30°	LEFT EYE 40°	RIGHT EYE 30°	RIGHT EYE 40°
No jerking	(6)				
Minimal	(2)				
Moderate	(3)				
Distinct, easily observed	(5)				
		TOTAL_____		TOTAL______	

Alternate Tests:

Romberg:

Anterior/Posterior - 45 sec trial

No significant sway	(0)	________
Slight sway, brief	(1)	________
Slight sway (Several episodes or continuous	(2)	________
Moderate sway, brief (1 or more stripes	(3)	________
Moderate sway (Several episodes or continuous)	(4)	________
Extreme sway, brief (Several stripes)	(6)	________
Extreme sway (Several episodes or continuous)	(8)	________

Add 1 - 2 points for following (max. score = 10)

Does not tip head, very rigid, tense, opens eyes, uses arms for balance.

OR

Required support/would not attempt/discontinued (2)

Total ________

Comments: ____

____

Subtraction: (or substitute counting)

Record TIME to perform sequence.

Record # of errors (omissions, repeats, wrong answers)

102-99-96-93-90-87-84-81-78-75-72-69-66-63-60

or

101-98-95-92-89-86-93-80-77-74-71-68-65-62-59

TIME_______ Number of Errors_______

Counting:

(Use if subt. appears too difficult for reasons other than intoxication)

Record TIME and ERRORS.

102-101-100-99-98-97-96-95-94-93-92-91-90-89-88-87-86-85-84-83-82-81-80-79-78-77-76-75-74-73-72

TIME_______ Number of Errors_______

Comments (Subt. or Count.)____

____

Letter Cancellation: 30 secs.

Line #________ = ________ minus ________ omissions = ________

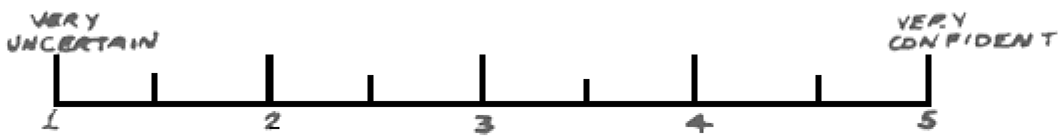
Comments ____

____

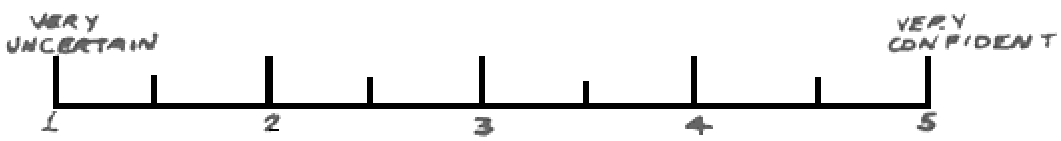
SUMMARY:	Test	Earned Score	Alternates
	1 - leg stand	______	Romberg______
	Finger-Nose	______	Subtraction______
	Finger-Count	______	Count backward______
	Walk-Turn	______	Letter cancel______
	Tracing	______	
	Nystagmus:		0 = No impairment 10 = Maximum impairment
	Left eye	______	
	Right eye	______	
	Earned total	______	Total possible = 70

Estimate of BAC:		
	______	0
	______	above 0, below .05%
	______	above .05, below .10%
	______	above .10, below .15%
	______	above .15, below .20%
	______	above .20%

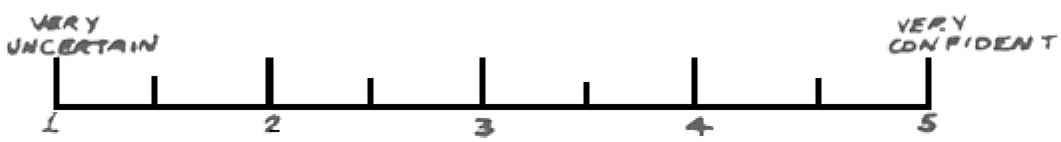
Mark on the scale below to indicate your confidence in your estimate of BAC.



Is this person impaired by alcohol?______Yes______ No.



Arrest?______Yes______no.



APPENDIX 6
False Alarms:
Arrest Decisions for Participants with BAC <.10%

Q-F-V Category	BAC	Nystagmus Score	Total Test Score
Heavy	.096	0	32
	.095	16	57
	.092	20	52
	.088	10	39
	.084	0	18
	.080	8	19
	.071	4	39
	.049	0	25
	.047	7	27
	.008	5	23
	.004	1	16
	.000	0	31
	.000	0	19
	.000	0	27
Moderate	.099	4	24
	.098	10	20
	.095	9	33
	.093	2	14
	.091	8	27
	.088	17	42
	.088	4	22
	.088	4	25
	.087	4	21
	.086	6	34
	.085	2	27
	.085	10	40
	.081	0	28
	.077	0	13
	.077	8	30
	.074	8	15
	.070	2	26
	.056	4	18
	.051	4	36
	.050	5	18
	.048	4	14
	.046	0	9
	.045	0	6

Light	.075	13	49
	.069	2	14
	.060	3	20
	.058	4	33
	.057	6	28
	.056	10	19
	.055	0	13
	.052	8	25
	.052	0	18
	.000	1	19

APPENDIX 7

Years of Service and DWI Arrest Experience of Officers Who Participated in Evaluation Study

Law Enforcement Agency	Officer's Yrs. of Service	Current Rate of DWI Arrests/Mo.	Total DWI Arrests
Santa Monica Police Dept. 2 Officers	2-1/2	10	110
	5	10	200
Calif. High-way Patrol 4 Officers	7	10	600
	2	10	180
	2-1/2	10	200
	10-1/2	10	400
Los Angeles Police Dept. 2 Officers	8	15	500
	3	0	150
Los Angeles County Sheriff 2 Deputies	7	30	2000+
	15	10	1000

APPENDIX 8

Summary of Stepwise Discriminant Analyses, BMDP7M

Classify participants as above/below .10% BAC

F to Enter/Remove	Variables Entered	Classification Matrix			% Correct	Classification Variables	Canonical Correlation
1.0	All test scores (without total score)		Below	Above		Total Nystagmus Tracing Walk-Turn Finger Count Nystagmus, Left Eye One-Leg Stand (Walk-Turn Removed)	.62978
		Below	156	17	90.2		
		Above	19	43	69.4		
			175	60	84.7		
2.0	All test scores (without total score)		Below	Above		Total Nystagmus Tracing Walk-Turn	.62278
		Below	152	21	87.9		
		Above	20	42	67.7		
			172	63	82.6		
2.0	Single tests: One-Leg Stand		Below	Above		One-Leg Stand	.39932
		Below	133	34	79.6		
		Above	22	40	64.5		
			155	74	75.5		
	Finger-Nose		Below	Above		Finger-Nose	.34414
		Below	127	41	75.6		
		Above	27	35	56.5		
			154	76	70.4		

F to Enter/Remove	Variables Entered	Classification Matrix			% Correct	Classification Variables	Canonical Correlation
(2.0)	Finger		Below	Above		Finger Count	.25049
	Count	Below	119	49	70.8		
		Above	27	36	57.1		
			146	85	67.1		
	Walk-Turn		Below	Above		Walk-Turn	.44165
		Below	135	32	80.8		
		Above	25	37	59.7		
			160	69	75.1		
	Tracing		Below	Above		Tracing	.40988
		Below	141	26	84.4		
		Above	28	35	55.6		
			169	61	76.5		
	Nystagmus-Left		Below	Above		Nystagmus-Left	.57470
		Below	151	17	89.9		
		Above	29	34	54.0		
			180	51	80.1		
	Nystagmus-Right		Below	Above		Nystagmus-Right	.59986
		Below	147	21	87.5		
		Above	19	44	69.8		
			166	65	82.7		

F to Enter/Remove	Variables Entered	Classification Matrix			% Correct	Classification Variables	Canonical Correlation
(2.0)	Nystagmus-Total		Below	Above		Nystagmus-Total	.60618
		Below	146	22	86.9		
		Above	20	43	68.3		
			166	65	81.8		
2.0	Test Subsets:		Below	Above		Total Nystagmus Tracing One-Leg Stand	.62232
	-One-Leg Stand	Below	153	20	88.4		
	-Finger-Nose	Above	21	41	66.1		
	-Tracing		174	61	82.6		
	-Total Nystagmus						
	-Finger-Nose		Below	Above		Total Nystagmus Tracing Walk-Turn	.62278
	-Tracing	Below	152	21	87.9		
	-Total Nystagmus	Above	20	42	67.7		
	-Walk-Turn		172	63	82.6		
	-Tracing		Below	Above		Total Nystagmus Tracing Walk-Turn	.62278
	-Total Nystagmus	Below	152	21	87.9		
	-Walk-Turn	Above	20	42	67.7		
	-Finger Count		172	63	82.6		

F to Enter/Remove	Variables Entered	Classification Matrix			% Correct	Classification Variables	Canonical Correlation
(2.0)	-Tracing		Below	Above		Total Nystagmus Tracing One-Leg Stand	.62232
	-Total Nystagmus	Below	153	20	88.4		
	-Finger Count	Above	21	41	66.1		
	-One-Leg Stand		174	61	82.6		
	-Tracing		Below	Above		Walk-Turn Tracing One-Leg Stand	.50848
	-Finger Count	Below	138	35	79.8		
	-One-Leg Stand	Above	19	43	69.4		
	-Finger-Nose		157	78	77.0		
	-Walk-Turn						
	-Walk-Turn		Below	Above		Total Score Tracing Walk-Turn	.50559
	-Finger-Nose	Below	140	33	80.9		
	-Finger Count	Above	19	43	69.4		
	-Tracing		159	76	77.9		
	-One-Leg Stand						
	-5-Score Total						
	-Walk-Turn		Below	Above		Total Nystagmus Total Score	.62394
	-Finger Count	Below	153	20	88.4		
	-Tracing	Above	20	42	67.7		
	-Total Nystagmus		173	62	83.0		
	-4-Score Total						

F to Enter/Remove	Variables Entered	Classification Matrix			% Correct	Classification Variables	Canonical Correlation
(2.0)	-Finger Count		Below	Above		Total Nystagmus Total Score	.62325
	-Tracing	Below	154	19	89.0		
	-Total Nystagmus	Above	18	44	71.0		
	-One-Leg Stand		172	63	84.3		
	-4-Score Total						
	-Tracing		Below	Above		Total Nystagmus Total Score	.61903
	-Total Nystagmus	Below	152	21	87.9		
	-Finger-Nose	Above	17	45	72.6		
	-Walk-Turn		169	66	83.8		
	-4-Score Total						
	-Tracing		Below	Above		Total Score Total Nystagmus	.61877
	-Total Nystagmus	Below	151	22	87.3		
	-Finger-Nose	Above	19	43	69.4		
	-One-Leg Stand		170	65	82.6		
	-4-Score Total						
	-One-Leg Stand		Below	Above		Total Nystagmus Total Score	.61722
	-Walk-Turn	Below	152	22	87.4		
	-Nystagmus	Above	18	44	71.0		
	-3-Score Total		170	66	83.0		

F to Enter/Remove	Variables Entered	Classification Matrix			% Correct	Classification Variables	Canonical Correlation
(2.0)	-Walk-Turn		Below	Above		Total Score Total Nystagmus	.61340
	-Total Nystagmus	Below	152	22	87.4		
	-2-Score	Above	17	45	72.6		
	Total		169	67	83.5		
	-One-Leg Stand		Below	Above		Total Score Total Nystagmus	.61236
	-Total Nystagmus	Below	152	22	87.4		
	-2-Score	Above	22	40	64.5		
	Total		174	62	81.4		
	Total Score (only) of:		Below	Above		Total Score	.60535
	-One-Leg Stand	Below	146	21	87.4		
	-Walk-Turn	Above	17	45	72.6		
	-Total Nystagmus		163	66	83.4		

Note N ≠ 238 because computer program excludes cases with extreme or missing values.

APPENDIX 9

STIMULUS PROGRAMMING SYSTEM (SPS)

System Description

The SPS is a versatile system for studying human control and information processing functions. It consists of four major subsystems:

(1) A control unit, including a punched paper tape reader and printer,

(2) A display unit,

(3) Subject response controls, and

(4) A tracking task generator.

The control unit is the heart of the system. It contains a microprocessor which is programmed to read experimental sequence instructions from a paper tape, execute the instructions, record response data, and print output data such as trial number, response accuracy, and response time.

The display unit presently contains three display systems:

(1) A tracking display located in the subject's central field of vision,

(2) Forty peripheral lamps located at the subject's eye level, and spaced every 5° from 15° to 100° visual angle, right and left, and

(3) Forty single-light numerical readouts which can be located in various arrangements in the visual field, typically 10 in each of four quadrants.

The response controls include:

(1) A tracking control lever which can either be a force stick or a displacement stick,

(2) A four-way switch to indicate the quadrant in which a target digit appears, and/or

(3) A push-button switch which can be used to indicate the occurrence of a target digit or a peripheral lamp signal.

The tracking task generator allows selection of a variety of tracking task configurations, including a choice of:

(1) Pursuit or compensatory tracking display,

(2) Position or rate control,

(3) Forcing function bandwidth, and

(4) Forcing function and display gains.

Two types of scores are displayed on digital readouts: (1) absolute error, and (2) absolute error squared. The tracking generator can be manually operated as a completely separate unit or can be controlled via the SPS control unit from punched tape commands. In the latter case, tracking error scores are also printed on the printer in addition to the discrete response data.

The experimental sequence instructions, which are punched in the paper tape, allow extremely flexible control over stimulus presentation. Typical applications of this system are described below.

Applications

The primary application of this system is to the study of division of attention, as related to task and stress variables. Task variables include central and peripheral task difficulty levels and the type of central and peripheral tasks (e.g., pursuit versus compensatory tracking; peripheral signal detection versus visual search and recognition).

A typical experimental configuration is the combination of a tracking task with a search and recognition task. While tracking, the subject must search a field of digits for a target digit. The digit field changes intermittently, i.e., one or more digits may change every few seconds. A target digit is presented at given intervals within the changing background field - the subject must search for and recognize the target digit and respond with the four-way switch to indicate the quadrant in which the target digit occurred. During the test session, cumulative tracking error scores are printed out at regular intervals and the time and accuracy of all responses, including false alarms and incorrect responses, are also printed out along with identification data.

Each type of task can be presented separately as well as in combination with the others to examine the effects of task loading and configuration on performance. If desired, the tracking task generator allows recording of appropriate analog signals for spectral analysis and human operator studies of control performance. Finally, facilities are available for incorporating eye movement recording into the system, permitting study of the relationships among visual search behavior, division of attention task loading, and task complexity.

Applications to Driver Performance Studies

The driving task consists of several components, including visual search, visual signal detection and recognition, manual control and information processing. A critical aspect of the overall driving task is the integration of each component task into a well-organized sequence of actions in which an appropriate level of attention is directed toward each component.

As indicated previously, the SPS system allows component tasks important for driving (e.g., control, visual search, detection, recognition, information processing) to be studied separately or in combination. Thus, the driving situation can be abstracted and performance can be examined under well-controlled conditions. Relative difficulty levels of component tasks can be varied, and the differential effects of stress or other independent variables on specific aspects of driving performance can be studied.

Summary of Data for
Stimulus Programming System (SPS) Participants

	BAC Group		All SPS Participants
	<.10%	≥ .10%	
	n=71	n=26	N=97
	45 men	19 men	64 men
	26 women	7 women	33 women
Mean Age (years)	26.82	27.54	27.00
Mean BAC	.033%	.123%	.057%
Q-F-V Classification:			
Light	29	0	30
Moderate	30	10	40
Heavy	12	16	27
Mean Scores:			
SPS			
Track E^2	73.75	81.78	75.90
RT (secs.)	7.02	8.65	7.45
Response Errors	4.55	8.65	5.65
∑z (Tracing, RT, Errors)	-0.43	1.15	-0.11
Sobriety Test Battery			
One-Leg Stand	2.31	3.48	2.61
Finger-to-Nose	2.51	3.87	2.86
Finger Count	2.58	4.69	3.14
Walk & Turn	2.58	4.96	3.23
Tracing	3.23	5.08	3.79
Nystagmus - Left	.94	4.58	1.92
- Right	.77	4.12	1.67
- Total	1.71	8.70	3.59
Total Score:	14.92	30.78	19.22

ADDENDUM
COMPARISONS OF MALE AND FEMALE PARTICIPANTS: DRINKING PRACTICES, BAC, AND TEST SCORES

Questions of gender-related differences are important to interpretations of the evaluation study findings and to potential use of the recommended sobriety test battery. It seems to be rather widely believed that, compared to men, women are (1) poorer drivers, (2) more susceptible to alcohol effects, (3) less likely to be arrested by the police, and (4) more difficult to deal with when under the influence of alcohol. Whether or not any of these beliefs is based in fact, some police officers report being reluctant to confront the intoxicated woman, who has a reputation for being uncooperative, belligerent, and tearful. This reluctance could create a bias in arrest rates, as could impairment assessment problems associated with sex-related differences in drinking-and-driving habits and alcohol-related impairment of driving skills.

In recruiting participants for the evaluation study, the variables of foremost interest were drinking practices and history, and it was not feasible to additionally specify exact numbers of men and women. Consequently the actual gender distribution simply reflects the male: female ratio of applicants. The total of 238 participants was comprised of 168 (71%) men and 70 (29%) women. Thus, in comparison to roadside survey data (Wolfe, 1974) which show 84% men and 16% women, or to the Borkenstein accident data (1964) with 78% men and 22% women, there is an over-representation of women. However, note that the two cited studies sampled night-time drivers primarily, and thus are not representative of the total driving population.

As will be discussed in detail in the following pages, the evaluation study data do not reveal any significant or important differences as a function of gender. However, it is necessary to add the qualifying statement that there are characteristics of these data which render findings in this particular area somewhat equivocal. Specifically, there were important differences, as can be seen in the following tables (Table A-1 and Table A-2) and figures (Figure A-1), between male and female participants in drinking practices and therefore in alcohol treatment level and BAC.

For example, almost half the men were heavy drinkers. In contrast, only 13% of the women were in the heavy-drinker category. These differences, which complicate the male-female comparisons, can be compared to drinking-category distributions in the general population. Cahalan et al. (1969) reported data from a nation-wide study of drinking practices. If those data are truncated, excluding abstainers and infrequent drinkers, as was the case

TABLE A-1
CLASSIFICATIONS OF PARTICIPANTS BY
DRINKING CATEGORY

	Q-F-V Category	Number of Participants	Percent of Participants
Men	Light	33	20
	Moderate	54	32
	Heavy	81	48
Total:		168	100
Women	Light	29	41
	Moderate	32	46
	Heavy	9	13
Total:		70	100

TABLE A-2
BAC DISTRIBUTIONS, BY GENDER

BAC	Number		% of Gender Group		Proportion by Gender of each BAC Level	
	Men	Women	Men	Women	Men	Women
0	55	23	33	33	71	29
0><.05%	11	10	6.5	14	52	48
.05%≥<.10%	49	27	29	39	64	36
.10%≥<.15%	37	10	22	14	79	21
.15%≥<.20%	16	--	9.5	-	100	-
	168	70				
	(71%)	(29%)				

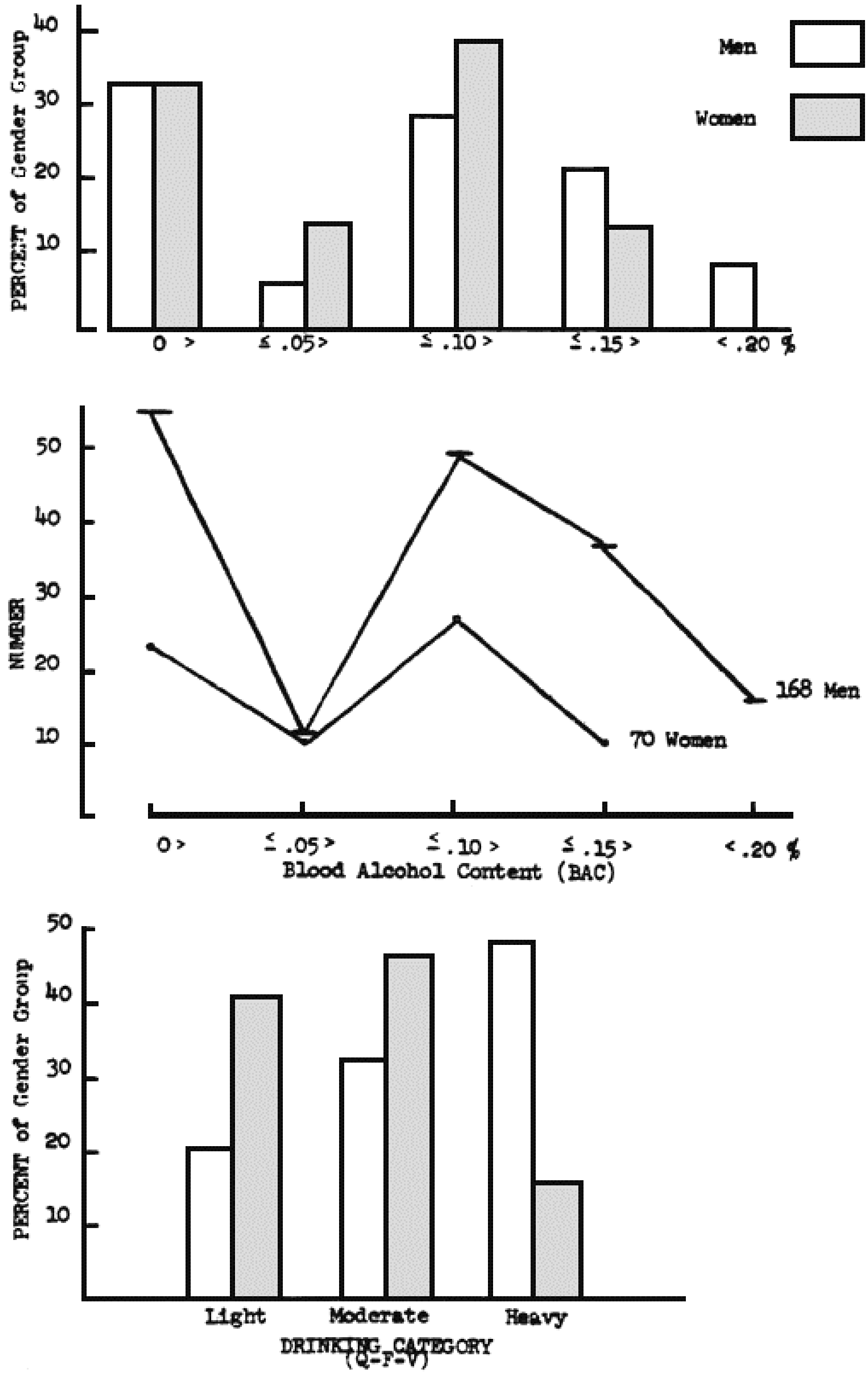


FIGURE A-1: Drinking Category and BAC Distributions with the evaluation study, and combining light and moderate drinkers as in the national data, the two samples can be compared. It can be seen in Table A-3 that classifications of the women in the two samples are remarkably similar, but there are substantial differences for the men. The evaluation study participants included a higher proportion of heavy drinkers than were reported by Cahalan et al.

Table A-4 presents a summary of correlation coefficients for test scores correlated with BACs. All r values are significant at the .01 level (with the exception of Finger Count Test, Women). Although the coefficients are higher for the men's data than for the women's, the differences are not statistically significant. Since the size of a correlation coefficient is directly related to the range of the correlated measures, the higher r for men in this case can be largely attributed to a wider range of both BAC and test scores (men: BAC 0 - .19%, scores 0 - 64; women: BAC 0 - .15%, scores 0 - 49). The correlations do not provide any evidence of differential scoring by the officers.

Of considerably more interest are the scatter plots of Figure A-2 and Figure A-3. Linear regression analyses, as detailed in Table A-5, locate the total-test-criterion scores (for prediction of above or below .10% BAC) at 28 for the men and 29 for the women. Using these criterion scores 81% of the women are correctly classified and 84% of the men are correctly classified. As can be seen in Table A-6 the officers' arrest/don't arrest decisions were considerably less accurate, but they demonstrated no important gender-related biases in the laboratory setting.

It is concluded that in the context of the evaluation study the tests served equally well for men and women, and the officers appear to have followed the same procedures and criteria for both. However, field study is needed to determine whether real-world circumstances would alter these findings with regard to differences by sex.

TABLE A-3
DRINKING CLASSIFICATION COMPARISONS:
EVALUATION STUDY AND NATIONWIDE
DRINKING PRACTICES STUDY

	Evaluation Study		Cahalan et al. (1969)	
	% of Men	% of Women	% of Men	% of Women
Light + Moderate	52	87	69	88
Heavy	48	13	31	12

TABLE A-4
CORRELATIONS: TEST SCORES - BAC

	Women n=70	Men n=168
One-Leg Stand,*	.469	.483
Finger-to-Nose	.419	.511
Finger Count	.190	.334
Walk-and-Turn*	.418	.590
Tracing	.393	.450
Alcohol Gaze Nystagmus*		
Left Eye	.549	.666
Right Eye	.507	.684
Both Eyes	.542	.698
Total Test Score	.618	.719

*Recommended Test Battery

All values of r sig. at .01 level with exception of non-sig. r for Women - Finger Count.

TABLE A-5
LINEAR REGRESSION ANALYSIS

Equation: $y = a_1x + a_0$

Women		Men	
$a_0 = 8.70$		$a_0 = 8.87$	
$a_1 = 201.06$		$a_1 = 189.55$	
BAC	Score	BAC	Score
.025	13.73	.025	13.61
.05	18.75	.05	18.35
.075	23.78	.075	23.09
.10	28.81	.10	27.83
.15	38.86	.15	37.30
.20	48.91	.20	46.78

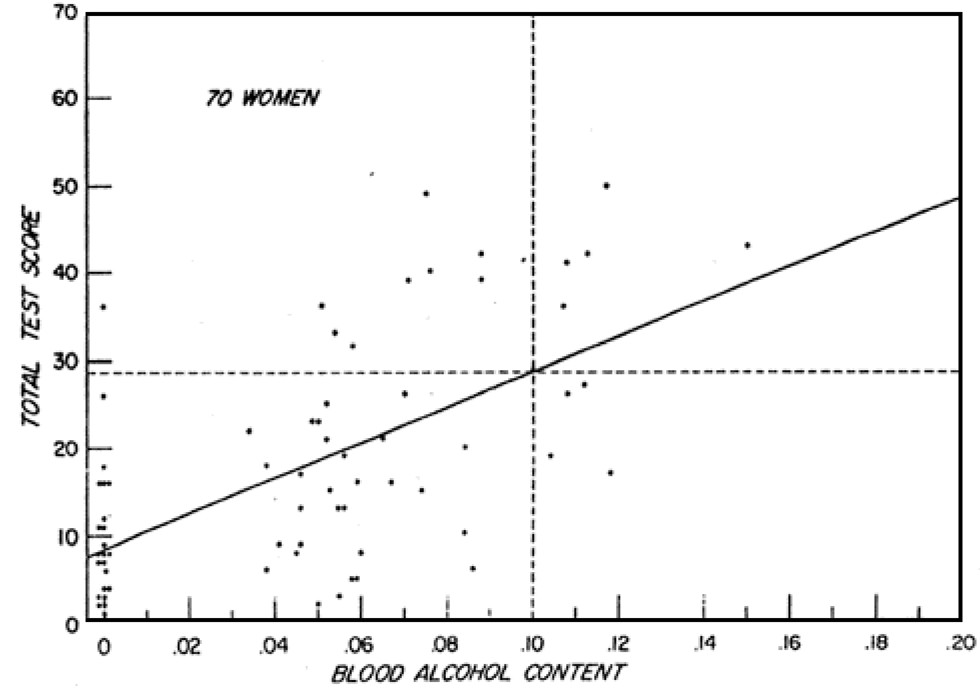


FIGURE A-2: Scatter Plot of Total Test Score/BAC for 70 Women

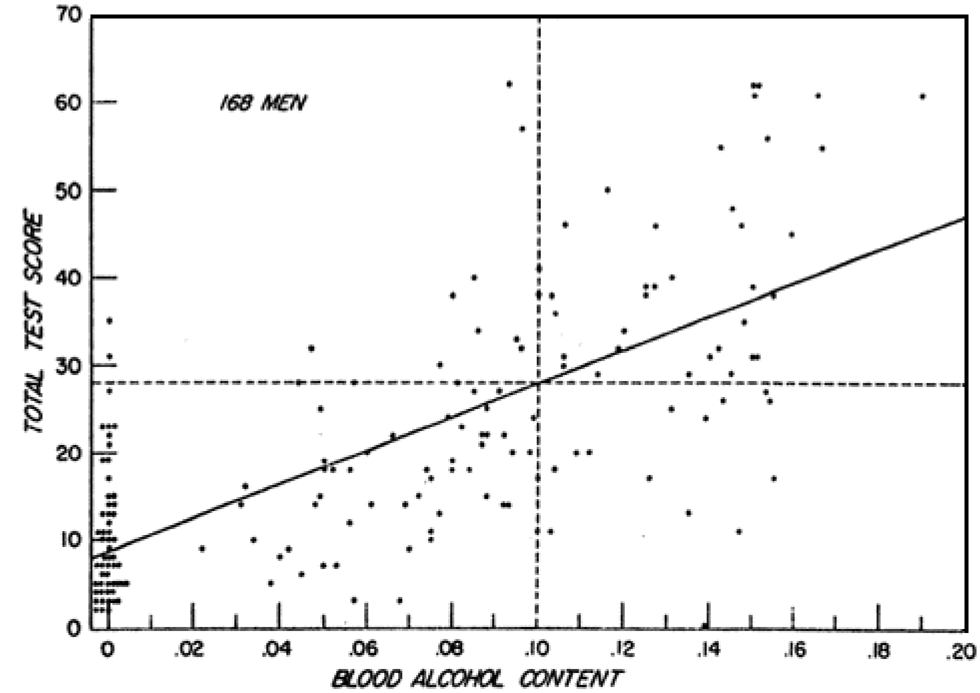


FIGURE A-3: Scatter Plot of Total Test Score/BAC for 168 Men

TABLE A-6
PERCENT CORRECT ARREST DECISIONS
BY MEN AND WOMEN

		%	
		Women	Men
Officers' Decisions:	Correct	77	76
	Incorrect	23	24
By Criterion Score:	Correct	81	84
	Incorrect	19	16

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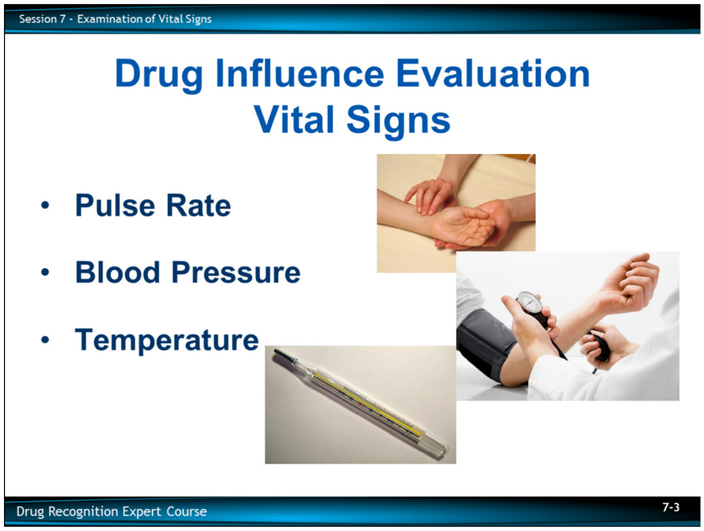
Borkenstein, R.F., Crowther, R.F., Shumate, R.P., Ziel, W.B., and Aylman, R. (Dale, A., ed.). The role of the drinking driver in traffic accidents. Bloomington: Indiana University, Dept. of Police Administration, 1964.

Cahalan, D., Cisin, I.H, and Crossley, H., American Drinking Practices. New Brunswick: Rutgers Center of Alcohol Studies, 1969.

EXHIBIT K



A. <u>Purposes of the Examinations</u>

The vital signs relevant to the drug influence evaluation include:
Point out these vital signs on the wall chart.

- Pulse Rate
- Blood Pressure
- Temperature

Different types of drugs affect these vital signs in different ways.

Certain drugs tend to "speed up" the body and elevate these vital signs.
Clarification:

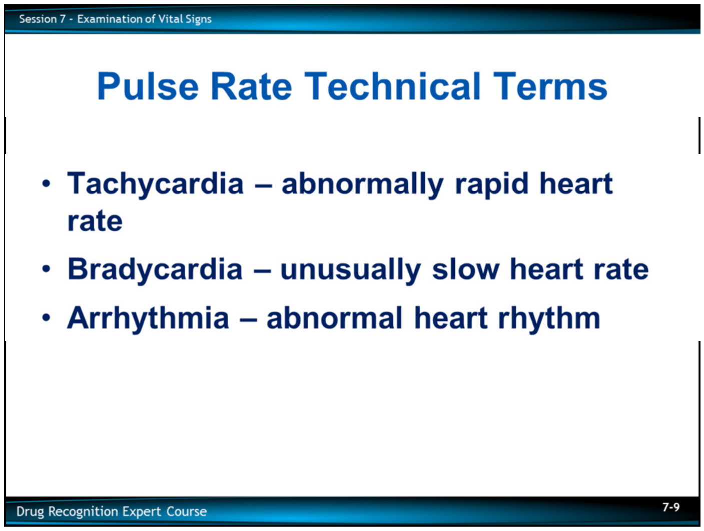
- Pulse may quicken
- Blood pressure may rise
- Temperature may rise

Other drugs tend to "slow down" the body and lower these vital signs.
Clarification:

- Pulse may slow
- Blood pressure may drop
- Temperature may drop

Systematic examination of the vital signs gives us much useful information concerning the possible presence or absence of various categories of drugs.

EXHIBIT L



Some Technical Terms Associated with Pulse Rate

- Tachycardia: abnormally rapid heart rate
- Bradycardia: unusually slow heart rate
- Arrhythmia: abnormal heart rhythm

Participants' Initial Practice at Measuring Pulse Rate

Instruct participants to work in pairs, taking turns measuring each other's pulse.

Tell participants to record on paper their partner's pulse rate.

Monitor, coach, and critique the participants' practice.

Allow the practice to continue for only about 5 minutes.

PRINT the following lists on the dry erase board or easel/easel pad.

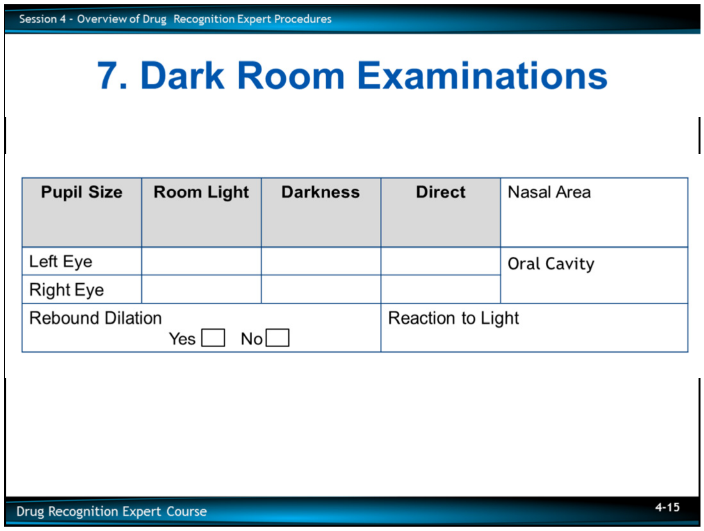
50 or less	***76-78***
52-54	***80-82***
56-58	***84-86***
60-62	***88-90***
64-66	***92-94***
68-70	***96-98***
72-74	***100 or more***

TABULATE the numbers of participants whose pulse rates were in each of the listed intervals.

Point out there is a wide variation in human pulse rates.

Point out the DRE average range or expected range for pulse rate is 60-90 beats per minute.

EXHIBIT M



Dark Room Examinations
Many categories of drugs affect how the pupils will appear and how they respond to light.

Certain kinds of drugs will cause the pupils to widen dramatically, or dilate.

Some other drugs cause the pupils to narrow, or constrict.

By systematically changing the amount of light entering the subject's eyes, we can observe the pupils' appearance and reaction under controlled conditions.

We carry out these examinations in a dark room, using a penlight to control the amount of illumination entering the subject's eyes.
Exhibit a penlight.

We use a device called a pupillometer to estimate the size of the subject's pupils.
Exhibit a pupillometer.

Point out the pupillometer has a series of circles or semi-circles of various sizes.
By lining the circles up along side the subject's pupil, the pupil's size can be determined.
Point out participants will have several opportunities to practice conducting dark room examinations later in the course.

Other examinations are also conducted in the darkroom, using the penlight, i.e., examination of the nasal area and mouth for signs of drug use and for concealed contraband.

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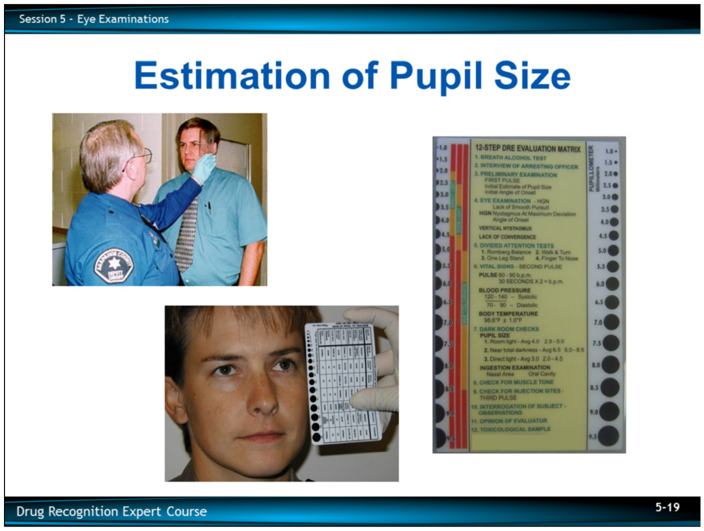
EXHIBIT N



Estimating Pupil Size
The pupils of our eyes continually adjust in size to accommodate different lighting conditions.
Exhibit a pupillometer.

We use a device called a pupillometer to estimate the size of the subject's pupils.

The pupillometer is held alongside the subject's eye, moved up and down until the circle or semi-circle closest in size to the pupil is located.
Demonstrate the positioning of the pupillometer.

Pupil size estimations are recorded as the numeric value that corresponds to the diameter of the circle or semi-circle that is closest in size to the subject's pupil in each lighting condition.
Select a participant and demonstrate pupil size estimation using the participant.

EXHIBIT O

H. <u>Examination of Muscle Tone</u>

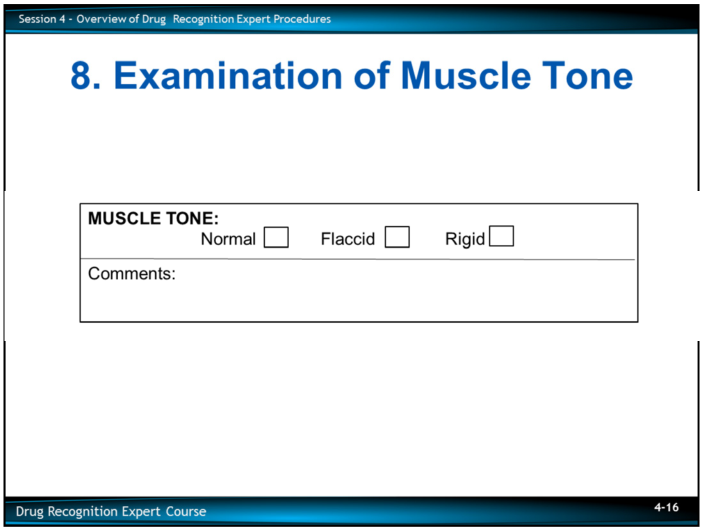
Muscle Tone
*S*tarting with the subject's left arm, examine the arm muscles.

Firmly grasp the upper arm and slowly move down to determine muscle tone.

The muscles should appear flaccid, normal, or rigid to the touch.
Demonstrate.

Examine the right arm in the same fashion.

EXHIBIT P



Examination of Muscle Tone

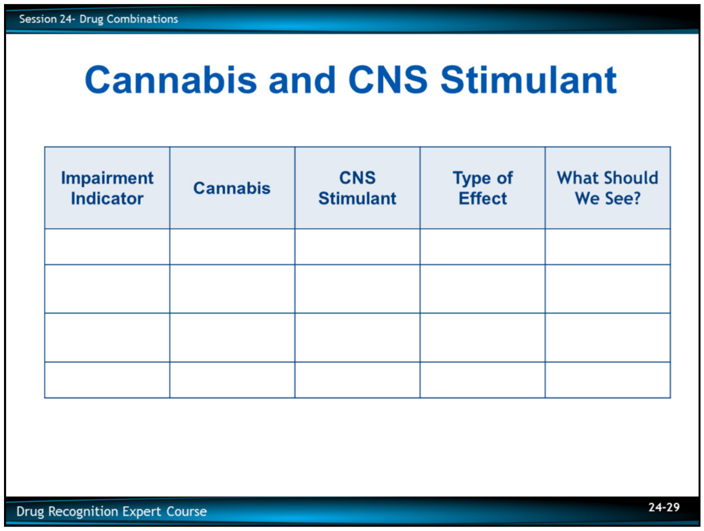
Evidence of muscle tone can also be observed when taking the subject's pulse, blood pressure, or while examining for injection sites.

Certain categories of drugs can cause the user's muscles to become markedly tense and rigid. Others may cause flaccidity or "rubbery-like" muscle tone.

Evidence of this muscle tone may come to light when the subject attempts to perform the divided attention tests.

Point out examination for muscle tone will be covered in greater depth subsequently in the course.

EXHIBIT Q



Pulse Rate

Ask participants: "What should we see when we measure this person's pulse rate?"

Both Cannabis and CNS Stimulants usually elevate pulse rate. This is an Additive Effect. We should see a pulse rate that is up or elevated.

Blood Pressure

Ask participants: "What should we see when we measure this person's blood pressure?"

Cannabis usually causes blood pressure to be up or elevated; so does a CNS Stimulant. This is another Additive Effect. We should see a blood pressure that is up or elevated.

Body Temperature

Ask participants: "What can we expect to find when we check this person's temperature?"

Cannabis usually does not affect body temperature. But CNS Stimulants usually elevate temperature.

Point out Cannabis in combination with CNS Stimulant produces an Overlapping Effect on body temperature.

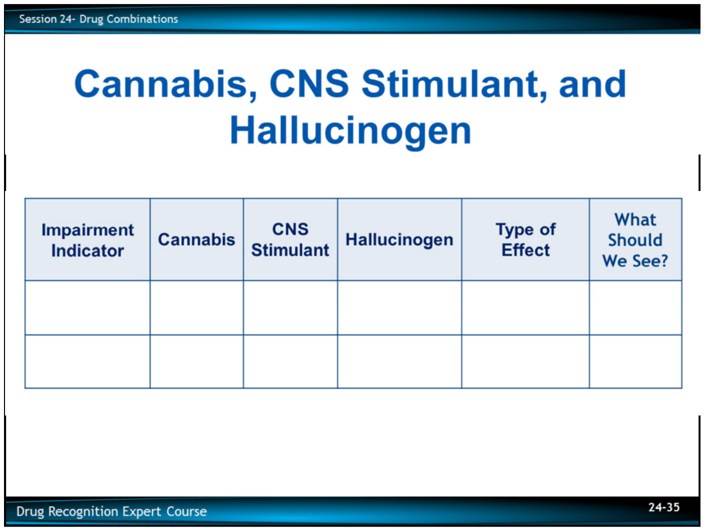
This is another case of action plus no action equals action. We can expect to see an elevated temperature with this combination.

Muscle Tone

Cannabis usually does not affect muscle tone. CNS Stimulants cause muscle tone to be rigid. This is another case of action plus no action equals action. We can expect to see rigid muscle tone with this combination.

Point out this particular combination produces no Antagonistic Effects.

EXHIBIT R



Body Temperature
Cannabis usually causes a body temperature in the average range. CNS Stimulants and Hallucinogens elevate body temperature. This would be an example of an Additive or Overlapping Effect.
Ask participants: What effect would take place and the result.

The body temperature should be elevated with this combination.

Muscle Tone
Cannabis causes a normal muscle tone, while CNS Stimulants and Hallucinogens will cause rigid muscle tone. This would be an example of an Additive or an Overlapping Effect.
Ask participants: What effect would take place and the effect.

The muscle tone should be rigid with this combination.