Impairment of Driving Related Abilities by Ethanol versus "Visible Impairment” (the Dram Shop Quandry)

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The Hilton
Baltimore, Maryland
November 13, 2013
INTERRELATIONSHIPS

Human  Vehicular

Environmental

FACTORS
Human Factors
Distracting Influences
Vehicular Factors
Tires
Brakes
Steering
Environmental Factors

Visibility
Pavement Conditions
Obstacles
Signage
SERVER
RESPONSIBILITY

Detecting Alcohol’s Influence
Dram Shop Laws

• Recognize that a “server of alcohol” bears some responsibility to not serve an impaired customer

• Vary state by state
  – Minors, social hosts

• Terms vary
  – Intoxicated
  – Visibly intoxicated
  – Impaired

• Do not remove aspect of personal liability
  – Some states do not allow one to sue for injuries to self
Some Components of Server Training

• **General Signs of impairment**, the customer may exhibit:
  - Has trouble focusing or glassy eyes
  - Has trouble maintaining eye contact
  - Exhibits fatigue, slumping in their chair
  - Looses their train of thought when speaking
  - Slurs speech esp. with polysyllabic words

• **Signs of coordination impairment**, the customer:
  - has difficulty handling change (fine motor coordination)
  - spills drinks or knocks things over
  - stumbles, uses arms as outriggers
Some Components of Server Training

• Signs of **judgment impairment**, the customer:
  
  - looses track of how much they’ve had
  - becomes careless with money
  - begins ordering rounds for total strangers
  - makes irrational or nonsensical statements
  - become argumentative or agitated

• Signs of **reaction impairment**, the customer:
  
  - is less aware of what’s happening around them
  - is less responsive to those around them
Servers may lack both the opportunity and proper motivation.
Some Alcohol Server Training Programs:

- **TIPS**  
  Training for Intervention Procedures

- **RBST**  
  Responsible Beverage Service Training

- **AlcoholCert**  
  Corporate Program offered in Utah and Arizona

- **ServSafe**  
  Program of the National Restaurant Assoc
Things that are:

**DIFFICULT to say** when you’re DRUNK:
Indubitably, Innovative, Preliminary, Proliferation, Cinnamon

**VERY DIFFICULT to say** when you’re DRUNK:
Specificity, British Constitution, Passive-aggressive disorder, Loquacious, Transubstantiate

**DOWNRIGHT IMPOSSIBLE to say** when you’re DRUNK:
1) Thanks, but I don’t want to have sex.
2) Nope, no more booze for me.
3) Sorry, but you’re really not my type.
4) Good evening officer isn’t it lovely out tonight?
5) Oh, I just couldn’t. No one wants to hear me sing.
6) Sorry I’m being such a jackass.
CLINICIANS

Detecting Alcohol’s Influence
Is Intoxication "Observable"?

- **Alcohol Symptom Checklist***
  - Odor of alcohol on breath
  - Fine motor control
  - Gross motor control
  - Slurred speech
  - Change in speech volume
  - Decreased alertness
  - Sweating
  - Slow or shallow respiration
  - Sleepiness
  - Pace of speech
  - Red eye

  * (ASC)

- "Non-intoxicated Signs"
  - Alert and Ambulatory
  - Passes simple mental status exam
    - Orientation
    - 3-step command
    - Correctly make change
  - No obvious neurological abnormality
  - Deemed responsible for self
Ethanol Levels in “Sober” ED Patients

- Definition of “non-intoxicated” (alcohol within 6 hrs)
  - Alert and Ambulatory
  - Passes simple mental status exam
    - Orientation
    - 3-step command
    - Correctly make change
  - No obvious neurological abnormality
  - Deemed responsible for self

Ethanol Levels in “Sober” ED Patients

3 Emer MDs exam 21 pts with suspected alcohol related symptoms

FIG. 1—Best-fit linear regression analysis of each individual scorer’s data.

ASC = Alcohol Symptom Checklist

Another trauma? “Don’t they ever arrest these people?”
Law Enforcement DWI Detection

The Process of **IDENTIFYING** and **GATHERING EVIDENCE** to Determine Whether or Not a Suspect Should Be ARRESTED for a DWI VIOLATION.

Steps in law enforcement detection

1. Vehicle operation
   - Vehicle in motion
   - Vehicle stopping sequence
2. Personal Contact
3. Pre-arrest screening
4. Post-arrest Testing
Driving is a complex task (DIVIDED ATTENTION) involving a number of subtasks, many of which occur simultaneously:

- Steer
- Control accelerator
- Signal
- Control the brake
- Operate the clutch
- Operate the gearshift;
- Observe other traffic;
- Observe signal lights, stop signs etc
- Make decisions (to stop, turn, speed up, slow down).

Before a stop, an officer may look for deviations in any or all of the above operations.
Law Enforcement DWI Detection

Visual cues of a vehicle **DURING OPERATION** by an intoxicated driver

**PROBLEMS MAINTAINING PROPER LANE POSITION [P=.50-.75]**

- Weaving or swerving
- Straddling lane line
- Wide turning radius
- Drifting in straight line

- Moving traffic violations
- Equipment violation
- Evidence of drinking in vehicle
- Near misses of object or other vehicle

**SPEED AND BRAKING PROBLEMS [P=.45-.70]**

- Stopping Problems (too far, too short, wrong angle, jerky)
- Accelerating or Decelerating Rapidly
- Operating slower than normal (10 mph or more under limit)
- Varying speed

Visual cues of a vehicle **DURING OPERATION** by an intoxicated driver
Law Enforcement DWI Detection

Visual cues of a vehicle **DURING OPERATION** by an intoxicated driver

**VIGILANCE PROBLEMS** [P=.55-.65]

- Driving in opposing lane or wrong way on one-way street
- Slow response to traffic signals
- Slow or failure to respond to officer’s signals
- Stopping in lane for no apparent reason
- Driving without headlights at night
- Failure to signal or signal inconsistent with actions

**JUDGMENT PROBLEMS** [P=.35-.90]

- Following too Closely
- Improper or Unsafe lane changes
- Illegal or improper turn (too fast, jerky, sharp, etc.)
- Driving on other than designated road
- Stopping at an inappropriate location in response to officer’s signals
- Inappropriate, unusual behavior (throwing objects, urinating roadside, etc.)
Post Stop Law Enforcement Detection
Law Enforcement DWI Detection

Visual POST STOP cues of a vehicle operated by an intoxicated driver $p > 0.85$

**While still in the vehicle speaking with the officer**
- Difficulty with motor vehicle controls
- Difficulty exiting the vehicle
- Fumbling with driver’s license or registration
- Repeating questions or comments
- Swaying, unsteady, or balance problems

**Exiting and after exiting**
- Leaning on vehicle or other object
- Slurred speech
- Slow to respond to officer or officer must repeat statements
- Providing incorrect information or changing answers
- Odor of an alcoholic beverage about person
What is the purpose of “Field Sobriety Testing”? 

• NOT whether you have a neurological condition
• NOT whether you appear impaired
• NOT whether you can safely drive a vehicle
• NOT whether you have had alcohol
• BUT, for Probable Cause that you are driving while intoxicated (or that you have a BAC > 0.08%)
Figure 3: Distribution of Blood Alcohol Concentration (BAC) Values Among Drivers and Motorcycle Operators With Positive BAC Values 2006

Illegal Per Se Level
BAC = .08

Median BAC = .16

2006 Traffic Safety Annual Assessment-Alcohol Related Fatalities NHTSA DOT HS 810 821
Which of these are the SFSTs?

- Detection of odor of alcohol on breath (or clothes, vehicle)
- Counting fingers forwards and backwards
- Counting backwards or math problems
- Romberg test for balance
- Finger to nose testing
- One leg stand
- Heel to toe walking
- Horizontal gaze nystagmus
- Slurred speech
- “glassy” or red eyes
- Nervousness or inattention
Which of these are the SFSTs?

- One leg stand
- Heel to toe walking
- Horizontal gaze nystagmus

Early correlation to BAC > 0.10 g%:

- 65%
- 68% (Combination as high as 83% “reliable”)
- 77%
Standardized Field Sobriety Tests

HGN  **Horizontal Gaze Nystagmus**
Jerking eye movements back and forth
Scoring: 1 point each eye for:
- Lack of smooth pursuit
- Jerking at max extension
- 45° Onset of jerking

WAT  **Walk and Turn**
Divided attention between counting 9 steps and balance
Scoring: Points for:
- Swaying while listening
- Using arms for balance
- Begins test early
- Looses balance on turn
- Stops to regain balance
- Wrong no. steps
- Not touching heel-to-toe

OLS  **One Legged Stand**
Divided attention between counting 30 secs and balance
Scoring: Points for:
- Swaying
- Using arms for balance
- Hoping to keep balance
- Putting foot down
Validity Testing of **SFSTs**

1981, Tharp, V., Burns M., and Moskowitz, H.
Trained Officers tested subjects both in the laboratory and in the field.

Tests included: HGN, OLS and WAT at **0.10% threshold**

Correct Classification:

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<th>LAB</th>
<th>FIELD</th>
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<td><strong>81%</strong></td>
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<td><strong>95%</strong></td>
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Best single test = **HGN**

= 78%

Progressive Impairment:
Mood, Perception, Judgment, Coordination
Alcohol impairs:

**Perception**
- Visual Cortex
- Recognizing, appreciating,

**Cognition and memory:**
- Pre-Frontal area
- Thinking, knowing, learning and judging
- Concentration, elaboration of thought

**Psychomotor Performance**
Textbook:
Signs and Symptoms of Intoxication

- Facial flushing
- Slurred speech
- Inappropriate behavior (too loud/aggressive, sexual)
- Sleepiness
difficulty staying alert/droopy
- Difficulty thinking clearly
understanding, remembering
- Uncoordinated movements
esp. fine motor movements
- Unsteadiness
(impaired balance)
Dubowski’s Stages of Acute Alcohol Influence

• **0.01 - 0.05 g/dl**  “Subclinical”
  – slight impairment, perceptual & emotional effects

• **0.03 - 0.12 g/dl**  “Euphoria”
  – decreased social inhibition, decreased emotional control, decreased judgment and cognitive function, decreased fine motor skills. Start of sensory-motor impairment

• **0.09 - 0.25 g/dl**  “Excitement”
  – Emotional instability, impaired perception, decreased memory, impaired coordination, impaired cognitive function

• **0.18 - 0.30 g/dl**  “Confusion”
  – Dizziness, blurred vision, slurred speech, significant impairment of cognitive, perceptual and related functions.

• **0.25 – 0.40 g/dl**  “Stupor”
  – Approaching loss of motor function, markedly decreased response to stimuli, impaired consciousness, stupor

• **0.35 – 0.50+ g/dl**  “Coma”
  – Anesthesia, depressed reflexes, hypothermia, impaired circulation and respiration, coma, death possible
WARNING!
CONSUMPTION
OF ALCOHOL
MAY CAUSE
YOU TO
HAY SHINGS
LIKE THIS

O’SMIT
BAR

IAN BAKER
<table>
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<th>Author</th>
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<th>Total Persons Examined</th>
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<td>Preg</td>
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<td>750</td>
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<td>Hine</td>
<td>100</td>
<td>6,594</td>
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<tr>
<td>All</td>
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Percent of Persons Found To Be “Drunk”

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<th>Alcohol and the Driver</th>
<th>JAMA 1986</th>
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<td>0.00-0.05</td>
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<tr>
<td>0.51-0.10</td>
<td>19</td>
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<td>0.101-0.15</td>
<td>59</td>
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<td>0.16-0.20</td>
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Setting and Bias

- "Odor of alcohol"
  - Nonspecific
  - Expected in the setting of alcohol service
- Euphoria, "having a good time", and altered judgment
- Tasks at a bar/restaurant/party vs. walking/driving
- Pre-event vs. Post-event
An observer’s abilities and relationship to a drinker determine his/her approach to the detection of intoxication

- **Trained**, unblinded researchers
- **Trained**, blinded researchers
- **Trained** clinicians
- **Trained** lay person with duty
- **Untrained** lay person with duty
- **Untrained** casual, sober observer with bias
- **Untrained** casual, **intoxicated** observer with bias
- **Untrained** casual observer without bias
Other Factors

• Ignorance of observer (i.e. “Odor of alcohol”)
• Alcohol tolerance of drinker
• Mood ("just having a good time")
• Distractions (tasks at a bar/restaurant)
• Timing (Pre-crash vs. Post-crash)
Opportunities to observe vary

Proper opportunity, motivation and training

Law enforcement during a stop

Compromised opportunity
But proper motivation and training

Clinicians after a crash
often **untrained**, poorly motivated, biased and may also be **intoxicated**

*Friend or Spouse*
Perception

*awareness* of the elements of environment through physical sensation
Sense apprehension + cognition

Visual perception Auditory perception

Laboratory:

Simple reaction time testing

Length of time for the motor component of the response is minimal compared to the time for sensory input
The man who is not drinking . . . can see to the sides of the road. As he becomes more and more intoxicated his vision is much narrowed and he sees only in front of himself and not too clearly there.
Attention

The cognitive process of selectively concentrating on one aspect of the environment while ignoring other things.

Also, the allocation of processing resources.

Laboratory

Measurement of choice reactions

The length of time for a response when two or more stimuli are presented requiring distinct responses or reaction times measured under conditions of divided attention.
Cognitive functioning

an intellectual process by which one becomes aware of, perceives, or comprehends ideas. It involves all aspects of perception, thinking, reasoning, and remembering.

Rates of information processing
Rate of judgment determination

Laboratory:

Measurement of choice reactions
Information processing is required for accurate responses. The interaction between speed and accuracy is thought to reflect the rate of information processing.
Sensorimotor coordination

The coordination of input-output elements of behavior. Established by the cerebellum, which coordinates multivariable senses (vision, hearing, etc.) and multivariable executors (the musculoskeletal system of the body).

Pursuit and continuous tracking tasks while maintaining lateral guidance control of an object following a prescribed path

Laboratory:
  Measurements of steering proficiency with oscilloscopes or driving simulators

Roadside:
  Finger-to-nose apposition
  Determination of body sway (Romberg’s test)
3 Types of Studies of Impairment

• Epidemiology
  – Retrospective, case controlled studies
  – Grand Rapids study

• Laboratory
  – Devices measuring visual acuity, balance, reaction time, etc.
  – Driving simulators

• Controlled Driving
  – Closed course driving
Epidemiological Studies

Measure the frequency and extent of intoxication in drivers involved in traffic accidents.

Frequently a control group is examined comprised of drivers, stopped at random, at a similar location and time.

These drivers also have alcohol measured in their blood (BAC) or breath (BrAC).

The most famous of all alcohol impaired driving studies, *The Grand Rapids Study*, is of this type.
Epidemiological Studies  The Manhattan Study  1962

Crash responsibility of 43 fatally injured drivers estimated.

26 drivers were assigned responsibility for the accident in which they were involved.

A control group of 156 drivers was randomly selected from a vicinity near the crash sites.

Alcohol shown to increase the risk of crash responsibility: 19 of 26 drivers (65%) responsible for accidents had a positive BAC; 14 of 26 (46%) had concentrations higher than 0.10% w/v.

In control group, 39 of 156 drivers (25%) were positive for alcohol, but only 8 (5%) had BACs above 0.10% w/v.

1750 drivers tested breath for alcohol

Utilized Dr. Rolla Harger’s *Drunkometer* in specially equipped vans over a one week period.

Random Controls: Only 12% of drivers randomly stopped tested positive for alcohol

Accident group: 46% of those hospitalized after a crash tested positive for alcohol

10x as many hospitalized drivers had BrACs over 0.10% as the random controls.

The data was not analyzed at 0.08%.

Epidemiological Studies  The Grand Rapids Study  1964

Case controlled study of 5,985 crashes of all types in Grand Rapids, MI.

3,305 (55%) drivers to whom responsibility for the accident was attributed.

2,680 (45%) drivers were considered not to be responsible.

The relative probability for being involved in an accident was calculated.
At a BAC of 0.08% the probability of being involved in an accident was many times that of an alcohol free individual.

This curve, which has been displayed and referred to countless times, is the single most significant demonstration of alcohol’s affect on driving related abilities.
Grand Rapids Study

Relative probability of involvement in single or multiple vehicle accidents.
Epidemiological Studies

Repeat of
the Grand Rapids Study 2002

Relative Crash Risk of Drivers at various BACs
Conducted in Long Beach, CA and Ft. Lauderdale, FL

2,871 crashes of all severities
10,066 control drivers

(2 drivers at same location, day of week & time of day as crash)

Conclusions: RP Compton et al

1. “The general correspondence of the univariate risk results from the present study and the Grand Rapids study in the 1960s suggest that the risk of drinking and driving has not changed since the earlier assessment.”

2. “Several covariates were found to significantly affect relative risk (age, gender, drinking variables, marital status, education, etc.).”

3. “The adjustment* of the risk estimates that were possible in this study show that the earlier risk estimates were likely a significant underestimate of the true risk produced by alcohol.”

* “The ability to adjust the relative risk model for potential biases reduced the attenuation of relative risk and provided a more accurate basis for decision-making.”
Laboratory Studies

Isolate factors believed to be involved in driving and impaired by alcohol.

Double-blind studies with controls.

Utilize equipment designed to measure the factor, e.g. a wobble-board for balance

Safety for study participants controlled in the lab.

No actual driving.
Complexity of task

Establish concept of normal and impaired function.

Extent to which the brain is being challenged

Similar and better learned tasks involving less concentration are not subject to as much impairment as poorly learned complex behaviors such as driving

• Herman Heise (1934)
  – “Habitual actions” (typewriter skill) unimpaired
  – “Unusual demands” (controlled driving) impaired
**Laboratory Studies**

- Review by Moskowitz & Robinson (1988)
  - Review of low dose alcohol impairment literature
    - surveyed approximately 400 studies but found only 177 which had adequate methods employed or described
    - the tasks were not all equally demanding and few studies were found examining BACs below 0.04%
  - Impairment demonstrated at low BACs by
    - “dividing attention” of subject on driving simulators
      - found impairment above 0.05% in steering, gear changing, braking response time, tracking, vehicle positioning, lane tracking, speed maintenance, reaction time, distance judgments and acceleration.

Moskowitz & Robinson (1988)

**Reaction Time**

Some studies found little or no effect by alcohol on reaction time, but the majority found impairment at BACs as low as 0.04%. Simple reaction times involving a single stimulus are much less affected than complex reaction times where discrimination among stimuli is also involved.

**Tracking moving objects**

Some reports of impairment at BACs as low as 0.02%, but most demonstrated significant impairment at 0.05%. When the tracking task was more demanding, the impairment was seen at lower BACs.
Moskowitz & Robinson (1988)

**Information Processing**

18 of 24 studies report impairment below 0.08%, some even as low as .015%

**Divided attention**

While there is little evidence of impairment below 0.08% for either concentrated attention (ability to focus on one thing) or vigilance (ability to attend to or detect an event over a long period of time), divided attention (ability to attend to more than one thing at a time) was found to be impaired at BACs less than 0.08% by a majority of the studies.
Laboratory Studies

• Review by Holloway (1994)
  –Review of low dose alcohol impairment literature published after 1988 (Moskowitz & Robinson)

Moskowitz & Robinson (1988)

<table>
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<th>Description</th>
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<tr>
<td>Dynamic visual acuity</td>
<td>The ability to see detail in an object in motion (dynamic visual acuity) has been shown to be impaired by a majority of studies below 0.08%. Simple acuity on the other hand has not.</td>
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<tr>
<td>Control over eye movements</td>
<td>At BACs less than 0.05%, alcohol increases the duration of eye fixations, impairing eye movement and the ability to merge two images into one.</td>
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<tr>
<td>Psychomotor performance</td>
<td>BACs of 0.05% and higher impair the ability to make fine, highly controlled muscular movements, to coordinate the movement of a number of limbs simultaneously</td>
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</table>
Driver Characteristics and Impairment at Various BACs

August 2000
DOT HS 809 075
Driver Characteristics and Impairment, NHTSA

Figure 2
DAT Raw Scores, All Subjects (N=168)

DAT = Divided Attention Task
Driver Characteristics and Impairment, NHTSA

Figure 3
SIM Raw Scores, All Subjects (N=168)

SIM = Driving Simulator
Results:  *Driver Characteristics and Impairment*, NHTSA

1. “…even at 0.02% BAC [alcohol] produces impairment in some important measures in the majority of Ss.”

2. “…of 336 statistical tests performed to evaluate differential alcohol effects as a function of age, gender, or drinking practices, only 22 reached the .05 significance level.”

3. “An approximation…assuming independence of statistical tests and using Fisher’s exact test, indicates that six positive tests out of 48 are required to reach at least a .05 level. Only the age variable approaches overall significance….however, six significant tests among four response variables at three BACs occurred in no consistent pattern.”
Conclusion:

“It is concluded, therefore, that within the limits of the population represented by the study sample, there is NO SIGNIFICANT EVIDENCE that either age, gender, or drinking practice produces a differential response to the impairing effects of alcohol.”