Marijuana-Impaired DUI: Using Research to Prove Your Case

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Words matter

When interpreting scientific studies, lab results, or even news stories, remember: "Marijuana" or "Cannabis" are umbrella terms covering a broad category of compounds. Precise language matters!

Delta-9 Tetrahydrocannabinol (THC)

- ACTIVE
- The primary psychoactive component in cannabis
- Makes the user feel high
- Causes the Euphoric Effect
- Detectible in blood for HOURS after last use (and MINISCULE amounts days & rarely weeks after last use by chronic users)

Metabolites

11 HYDROXY THC

- The main psychoactive metabolite of THC formed in the body after marijuana consumption

11-nor-9-Carboxy-THC (Carboxy-THC)

- Inactive metabolite
- Present in urine and blood
- Detectible hours/days after last use
- Not reliable without further evidence to prove impairment

We are looking for WEED in all the wrong places!

Biggest misconception – there has to be THC in the blood for the user to be impaired by marijuana

There are so many variables that will affect the nanograms in the blood…not the least is TIMING

Time of last use

Time of the blood draw

Time for the Search Warrant

Marijuana is LIPOPHILIC (FAT Soluble)

How does marijuana work in the body?

- Marijuana is ingested
- Impairment peaks quickly and then seems to level out

- THC binds to the fat receptors in the body/brain
- THC crosses the "blood/brain barrier" quickly

Kool-Aid example

The Takeaway?

Marijuana impairment peaks AFTER the majority of THC has moved out of the blood.

We test a subject's blood to determine the concentration of THC.

That number in the blood isn't quite the "tell all" as it might be for alcohol in the blood.

It's the Brain, Stupid

Mental v. Physical Impairment

MARIJUANA - impairment (generally) more of mental impairment.

ALCOHOL AND OTHER DRUGS - (generally) include more obvious (when you know what you are looking for) physical impairment

Executive Function – Where marijuana goes to impair.

What are executive functions?

- Goal-directed Behaviors
- Organizational Abilities
- Time Management Activities
- Strategic, Purposeful, Analytic, and Critical Thinking

Executive function challenges (Dr. Thomas Brown)

Action – monitoring and self-regulating actions
Memory – utilizing working memory and accessing recall
Emotion – managing frustrations and modulating emotions
Effort – regulating alertness, sustained effort and speed
Focus – focusing, sustaining and shifting attention to tasks
Activation – organizing, prioritizing and activation to work

Cognition + Physical Movement -> Psychomotor Function

Psychomotor Impairment Affects:

- Movement and Coordination
- Manipulation and Dexterity
- Grace
- Strength
- Speed
- Vigilance
- *Cannabis impairs psychomotor performance
- *Leads to altered driving ability in driving simulators & on-the-road driving tests

How marijuana affects the brain (sources: Igor Grant, University of California Center from Medicinal Cannabis Research; WSJ research)

THC, a key ingredient in marijuana, attaches to cannabinoid receptors throughout the body. Several areas of the brain have high densities of these receptors, which helps explain the different effects of the drug.

How the receptors work – nerve cells communicate by passing chemical messages across contact points called synapses. The most active ingredient in marijuana, delta-9 THC, attaches to cannabinoid receptors and modifies never action.

Some areas with high concentrations of cannabinoid receptors:

Cerebral Cortex – plays a role in memory, thinking, perceptual awareness and consciousness. Corresponding effects of marijuana – altered consciousness; perceptual distortions; memory impairment; occasional delusions and hallucinations

Hypothalamus – governs metabolic processes such as appetite. Corresponding effects of marijuana – increase appetite

Brain stem – controls many basic functions including arousal, the vomiting reflex, blood pressure and heart rate. Corresponding effects of marijuana – nausea relief; rapid heart rate; reduced blood pressure; drowsiness. Also plays a role in pain sensation, muscle tone and movement. Corresponding effects of marijuana – pain reduction; reduced spasticity; reduced tremor

Hippocampus – is key to memory storage and recall. Corresponding effects of marijuana – impairment in memory

Cerebellum – governs coordination and muscle control. Corresponding effects of marijuana – reduced spasticity; impaired coordination

Amygdala – plays a role in emotions. Corresponding effects of marijuana – Anxiety and panic in some cases; reduced anxiety and blocking of traumatic memories in other cases; reduced hostility

Executive Function (Dr. Huestis)

Attention - Selectively attending to one cue while ignoring others, including divided & sustained attention

Concentration - Intense mental application

Decision-making - Process of selecting a course of action

Impulsivity -Initiation of behavior without adequate forethought

Inhibition - Imposing restrain on behavior or another mental process

Reaction Time - Lapse of time between presentation of a stimulus & a response

Risk Taking- Engaging in behaviors that have the potential to be harmful or dangerous

Verbal Fluency - Generating multiple, verbal responses associated with a specified conceptual category

Working Memory - Ability to hold & manipulate information & remember it after a short delay

Science Has (SOME) of the Answers

Be a Critical Reader

- Know what you are reading or what's being referenced
- Relative analytical weight
- Bias
- Peer-reviewed
- Methodology

More things to consider

- Research design
- Measurement
- Analysis
- Statistical methods and conclusions
- Terminology
- Matrix the study is using

Not all Studies are Created Equal

THC Concentration Used in Most Government Studies is between 3-6% THC

Does this mean the studies are invalid?

Titration? Gold fish example

Drug Impaired Driving Approaches (Studies)

- Empirical
- Epidemiological
- Experimental
  - Laboratory
  - Simulator
  - On-the-road

Traffic Crash Epidemiology

- Culpability Data
- Case Control
- Meta-Analysis

Early culpability studies have a lot of issues and problems with them which is why they don't carry much weight or meaning – remember to be a critical reader

Problems in Epidemiological Studies

- Not blind to drug condition
- Lack statistical power
- Small number of cases

- Delays in collection of specimen
- Lack of sensitive quantitative analysis
- Documented presence of drug with inactive metabolite rather than active THC

More problems ahead

- Inconsistent Results
- No Adequate Control Group
- Blood Not Drawn for Many Hours
- No Quantification of Results
- Testing for Metabolites
- High LOQ (level of quantification)
- Few Cannabis Only cases
- Good for demonstrating alcohol impairment, less successful for marijuana impairment for the above reasons

Virginia Beach – NHTSA Alcohol & Drug Crash Risk Study

Used to support defense positions. WHY?

Performance Assessment

Laboratory

- Psychological Functions
- Cognitive and Psychomotor skills related to driving
- Memory
- Divided and Sustained Attention
- Reaction Time
- Tracking Performance
- Motor Control

Issues

- Can the results be generalized to driving?
- Are they relevant to driving?

Simulator and On-Road Driving Studies

Assess effects of cannabis on actual driving

- Road tracking (weaving, SDLP)
- Car following (brake reaction time, speed adaptation)
- City driving (visual search, anticipation to traffic, decision making)

Prediction Models

Controlled administration use to construct models for predicting the time of last THC use within 95% CI (confidence interval)

Accuracy when applying Model I and II with 95% CI

Following 1st cigarette – 99.5% No underestimations, max overestimation 4 min

Following 2nd cigarette– 98.6% No underestimations, same max overestimation

Take Model 1 and Model 2 – take the lowest number and the highest number of your two models for your range - 100% fell within the range

Benefit of the doubt goes to the defendant because no underestimations shown

Both models can be used in court to estimate time since last cannabis use

Use this information to corroborate or discount the accused person's story

The models are NOT retrograde

- Models work well with occasional users anytime and chronic frequent users during use, won't work when you are down to residual THC left in the tissue
- Models fail with sustained abstinence in chronic frequent users due to residual
- Good rule of thumb not to use the models on chronic frequent user
- For the models you must have THC and Carboxy-THC in blood

Counter-Clockwise Hysteresis – Concentration Curves (Dr. Huestis)

VAS Feel Drug

Heart Rate

Generally Passive Inhalation is NOT a Valid Defense

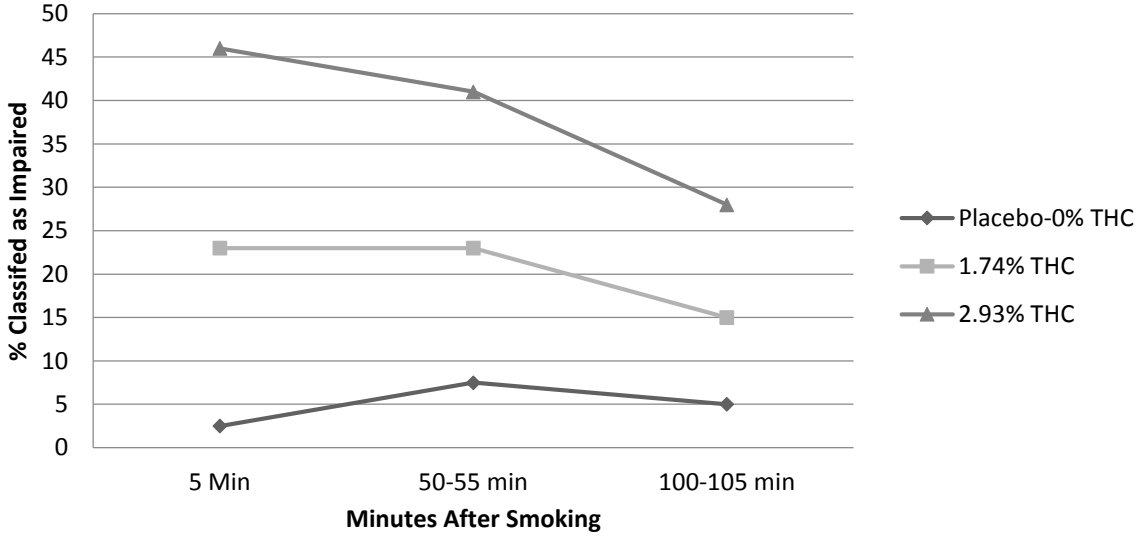
The non-realistic situation is so severe it is noxious and participants had to wear goggles

AND if there is THC in the blood they would feel the effects

<u>An Evolution of the Sensitivity of the Standardized Field Sobriety Tests to Detect Impairment Due to Marijuana Smoking. Papafotiou, Carter and Stough (2004)</u>

- Study evaluated One Leg Stand, Walk & Turn and HGN
- Subjects tested at 5 minutes, 55 minutes and 105 minutes after smoking
- Subjects were dosed with either Placebo, 1.74% THC or 2.93% THC

The Results



Placebo at 5 min – blood THC ng/mL = 0; Impairment observed = 2.5%
Placebo at 50-55 min – blood THC ng/mL = 0; Impairment observed = 7.5%
Placebo at 100-105 min – blood THC ng/mL = 0; Impairment observed = 5%
1.74% THC at 5 min - blood THC ng/mL = 55.5; Impairment observed = 23%
1.74% THC at 50-55 min - blood THC ng/mL = 6.8; Impairment observed = 23%
1.74% THC at 100-105 min - blood THC ng/mL = 3.7; Impairment observed = 15%
2.93% THC at 5 min - blood THC ng/mL = 70.6; Impairment observed = 46%
2.93% THC at 50-55 min - blood THC ng/mL = 6.2; Impairment = 41%
2.93% THC at 100-105 min - blood THC ng/mL = 3.2; Impairment = 28%

Why the 5 nanogram?

- Limited supporting research
- Whole Blood v. Serum
- A nearly impossible feat
- NOT like alcohol
- Picked the Middle Ground

Meanwhile, in Colorado…

PRO MJ Position -> wanted 10-30 nanogram Per Se TOTAL impairment

BILL SUPPORTERS -> No whole blood/serum conversion led to…

COMPROMISE -> Using Ramaekers study to reach 5 ng Δ-9-THC (whole blood) permissible inference

Studies and existing data aren't exactly mirroring what we are experiencing on the roads

- Edibles and Concentrates
- Chronic, Frequent versus Naïve users
- Small Sample Populations

WA State Fatal Crash Data 2015

- 85% of drivers in fatal crashes tested positive for active THC
- Approx. 50% were over 5ng
- 50% also had alcohol
- Highest was 70ng

Wait for it… DRE survey of 302 MJ-only cases

- 114 below 5ng (38%)
- 188 at or above 5 ng (62%)
- Mean blood: 8.1 ng

Peer Reviewed Study coming this summer 2016

HUGE number of variables influence how much THC is stored and for how long it is detectable in the blood, peaks of the drug, user self-reported impairment, and overall impairment

- Metabolism
- Frequency of Use

- Method of Ingestion
- Strain and Potency of Drug

ESTIMATED Duration of Effects

Marijuana

- Peak 20-30 minutes
- Duration 2-3 hours
- Dissipates 3-6 hours
- Residual Effects Up to 24 hours

The method of ingestion (e.g. smoked versus consumed in an edible) will affect the peak and duration of effects (and generally result in a lower high).

Effects of Cannabis on Driving

Cannabis & Alcohol Affect Driving Differently (Dr. Huestis)

Cannabis

- Attempted compensation
- Caution in experimental settings
- Can perform simple tasks, but impaired higher-level cognitive function

Alcohol

- Lowered inhibitions
- Faster driving
- Decline in visual and auditory perception and processing functions

Both Alcohol and Cannabis

- Control loss
- Inability to process changes
- Divided attention
- Concentration
- Tracking/Lane position
- Increased reaction time

Cannabis Effects on Driving

- Decision-making
- Divided attention
- Visual search
- Focus, concentration
- Process changes
- Reaction Time
- Road tracking, vehicle control

<u>Cannabis Effects on Driving Lateral Control with or without Alcohol Hartman, R.L., et al. (2015)</u>

First study to look at blood THC concentrations and its effect on SDLP (Standard Deviation of Lane Position)

18 adults

Use marijuana more than 2x a month but less than 3x a week

Light to moderate drinkers

Driving more than 2 years

Study Procedure

Entered study 10-16hrs before first dose

Alcohol provided to reach .065

2.9% THC or 6.7% THC

Placebo

45 min drive – began 30 min after dosing various combinations

Three Scenarios

Varied Event Orders

Same number of curves and turns

Pedestrians

Potential Hazards

URBAN SEGMENT

- 25-45 mph
- Controlled and Uncontrolled Intersections

INTERSTATE SEGMENT

- 4 lane express
- 72mph posted

RURAL SEGMENT

- 2 lane, undivided
- Curves
- Gravel portions
- 10 min straightaway

Blood Collection

Measured THC Concentrations
Measured BrAC

TIME INTERVALS COLLECTED POST DOSE

- 10min
- 25min
- 60min (during drive time)
- 1 hr. 25 min (immediately post drive time)
- 2 hr. 18 min

- 3 hr. 18 min
- Additional intervals ending with 8 hr. 18 min*

STANDARD DEVIATION OF LANE POSITION

.05 BrAC ~ 8.2ng THC in in blood

.08 BrAC ~ 13.1ng THC in blood

.08 BrAC ~ .05 BrAC + 5ng THC in blood

CANNABIS

- 5ng: SDLP increase 4.1%
- 10ng: SDLP increase 8.2%
- 20ng+: SDLP increase 16%

ALCOHOL

- .05 BrAC: SDLP increase 6.7%
- .08 BrAC: SDLP increase 11%
- .10 BrAC: SDLP increase 13%

What else?

Additive effect

Blood was collected during drive time to determine THC blood concentrates and/or Breath Alcohol Content

Effects of Blood Collection Time on Measured Δ9-Tetrahydrocannabinol Concentrations: Implications for Driving Interpretation and Drug Policy Hartman, R.L., et al. (2016)

Objective:

To analyze blood THC concentrations

- Post inhalation
- During driving
- Post driving

Compare THC concentration at the time of driving with post driving concentration associated with the collection of forensic draws

Study Procedure

Same study criteria and data
Alcohol provided to reach .065
2.9% and 6.7% THC used - titration
Placebo
45 min drive – began 30 min after dosing various combinations

Time after Inhalation:

10 min

- 38.2ng w/o alc (11.4-137ng)
- 47.9ng w/alc (13-210ng)

60 min (during drive)

- 6.0ng w/o alc (1.4-19.8ng)
- 6.2ng w/alc (1.8-26.7ng)

25 min

- 11.9ng w/o alc (1.6-40.8ng)
- 11.8ng w/alc (3.1-43.9ng)

1 h 25 min (end drive)

- 4.1ng w/o alc (0-14.7ng)
- 4.4ng w/alc (1.3-18.4ng)

2 h 18 min

- 2.7ng w/o alc
- 2.5ng w/alc

Rate of Decrease of THC in the Blood

10min to 25min = 73.5% (75.1%)
25min to 60min = 85.3% (87.3%)
60min to 1h 25min = 90.3% (91.3%)
1hr 25min to 2h 18min = 94.6% (95.5%)
2h 18min to 3h 18min = 96.9% (97.9%)

Residual THC in the Blood

RESIDUAL THC CONCENTRATIONS + PLACEBO

- Blood concentrations fluctuated around pre-dose baseline during all time intervals
- RESIDUAL THC CONCENTRATIONS + ACTIVE DOSE
- The rate of decrease of THC concentrations in the blood was similar to those without residual THC
- Both groups returned to respective baselines

***1 participant had residual concentrations of 4.9-6.3 in all sessions

KEY POINTS

- Median blood THC concentrations did not exceed 5ng by 2hours post drive (3h 18min post dose)
- Those with driving blood concentrations associated with impaired lateral controls (SDLP) (≥8.2ng) had median THC conc. between 2-5ng 2 hours post drive
- Cannot use back extrapolation due to variability in
  - Amount of intake and oral vs. smoked
  - Frequency of use
  - Metabolism/elimination rate
- THC effects are directly related to brain concentrations
- It is not possible to assess brain concentrations
- Peak effects DO NOT coincide with maximum blood concentrations
- Blood concentrations at time of blood collection in typical DUID cases will be substantially lower than concentrations during driving

  – Per se laws are unworkable

Chronic Frequent Cannabis Smokers

Impairment in Chronic Frequent Cannabis Smokers

Cognitive Measures in Long-Term Cannabis Users Pope et al., (2002)

- Heavy cannabis use produces residual neuropsychological deficits that may last for many days after cannabis is discontinued
- [D]aily or even near-daily cannabis users will effectively experience cognitive impairment on a continuous basis..
- Still a question: "whether long term cannabis use may produce cumulative neurotoxicity"

Impact of Prolonged Cannabinoid Excretion in Chronic Daily Cannabis Smokers' Blood on Per Se Drugged Driving Laws Bergamaschi et al., (2013)

- Fewer than 50% of blood samples from chronic daily smokers were THC positive after 16 days
- The last THC positive blood samples were from 2 individuals on day 30 (with previous samples being both negative and positive)(15-17yr smokers)
- [C]annabinoids can be detected in blood of chronic daily cannabis smokers during a month of sustained abstinence. This is consistent with the time course of persisting neurocognitive impairment reported in recent studies.

Psychomotor Function in Chronic Daily Cannabis

Smokers during Sustained Abstinence Bergamaschi et al., (2013)

- Psychomotor performance in critical tracking & divided attention tasks in daily smokers was impaired at baseline relative to occasional drug users
- Sustained cannabis abstinence moderately improved critical tracking & divided attention performance, but impairment still observable in critical tracking after 3 weeks of abstinence
- Withdrawal contributed to some impairment but not all impairment
- 8 of 12 had THC in blood after 3 weeks of abstinence –mean concentrations were approx. 1-2.5ng

Document and Argue in Court

Make the argument

Other plausible, alternate explanations or defenses to impaired driving do not automatically cause us to not prosecute a case!

Look for signs of impairment to decide the strength of the case!

Educating the jury and public about marijuana impairment is part of the process

Not all impairment looks the same (just like with alcohol)

Whose job is it to tie up the loose ends?

OBSERVE AND DOCUMENT WITHOUT JUDGMENT

What can you SEE?
What do you SMELL?
What do you HEAR? What can you TOUCH/collect?

The more you can ask about what the suspect uses, how much, how often, for how long, the more evidence you can get out

Marijuana isn't a simple "check these boxes, have this number" type of DUI case. You have to dig little deeper, think critically, use your experts.

How to use Scientific Studies in Court

Call the defense expert – ask them what studies they are relying on

Call your toxicologist and go over those studies

Ask if toxicologist has studies providing counter arguments

Work with the toxicologist to come up with questions for the defense expert

In Court: If the defense expert is referring to the study and/or quoting, ask him/her where that is coming from and then have them read the larger paragraph or rest of the section, etc. to make sure that's an accurate portrayal of the information

Scientific studies are always going to lag behind real-life use and what law enforcement is experiencing in real time on the streets

There is no "magic" study that will prove everything we ever wanted to know about marijuana impairment – it's literally changing daily, along with our understanding of it

What is the most effective way to build your case?

Go back to "old school" policing – observe and document EVERYTHING you see that demonstrates impairment

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