Driving Under the Influence of Cannabis: Evaluation of the Field Sobriety Tests

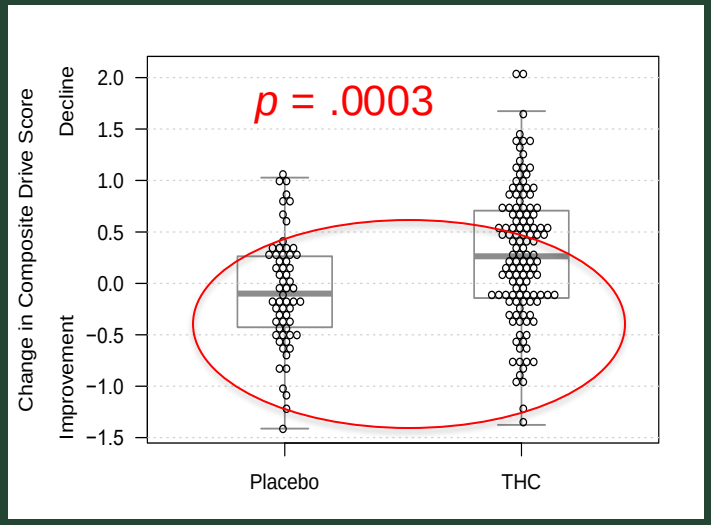
Thomas D. Marcotte, PhD

Center for Medicinal Cannabis Research (CMCR)

University of California, San Diego

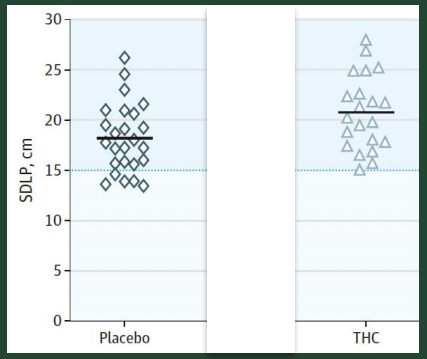
UC San Diego
CENTER FOR MEDICINAL CANNABIS RESEARCH

Not all individuals exposed to THC demonstrated significant declines in driving performance

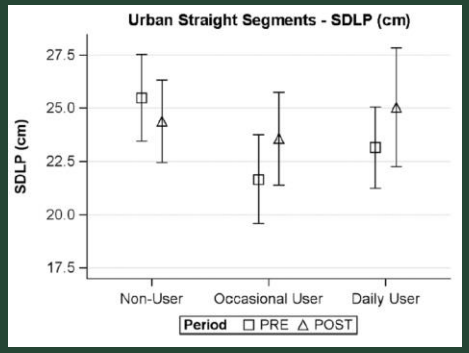


45.6% Impaired

Marcotte et al., 2022



Arkell et al., 2020



Brooks-Russell et al., 2021

Critical to differentiate between those who are or are not significantly impaired by acute THC exposure

Identifying Impaired Drivers

- Real-world determination of driving impairment made by law enforcement
  - » Vehicle in motion (driving behavior)
  - » Driver interviews
  - » Field sobriety tests (FSTs)
  - » Toxicology

  - » Possibly followed by more comprehensive Drug Recognition Expert (DRE) evaluation

Approaches to Validation
Laboratory Studies

Typically performed within a controlled environment, with carefully screened participants and known dosing

FST/cannabis laboratory studies – Limitations of previous studies

- Small sample sizes (e.g., 20 participants)
- Not administered by law enforcement: Administered by research assistant or investigator
- FST evaluations not reflective of real-world setting
  - » Multiple FST exposures (e.g., 6) due to a cross-over design
  - » FSTs before drug administration
- Studies generally conclude that FSTs are not sensitive, or are moderately sensitive, to THC effects

Study Design

- 184 regular cannabis users
- Parallel design
  - » Maintain blind, generalizability, attrition
- Smoke *ad libitum*
  - » 0% THC (n = 63)
  - » 5.9% THC (n = 66)
  - » 13.4% THC (n = 62)
- **Field Sobriety Tests**
  - » Administered by Drug Recognition Experts (DREs)
  - » First evaluation after treatment
  - » FSTs
    - Walk and Turn (WAT)
    - One Leg Stand (OLS)
    - Finger to Nose (FTN)
    - Lack of Convergence (LOC)
    - Modified Romberg Balance (mROM)
    - ~~Horizontal Gaze Nystagmus (HGN)~~

Inclusion/Exclusion Criteria

Inclusion Criteria

- Aged 21-55
- Licensed driver with >1,000 miles driven in prior year
- Regular cannabis user (≥ 4x per month)

Exclusion Criteria

- History of traumatic brain injury
- Significant medical conditions or psychiatric conditions
- Positive urine screen for non-prescription amphetamines, benzodiazepines, barbiturates, opiates, oxycodone, as well as cocaine, methamphetamine, or phencyclidine
- Past year substance use disorder
- Oral fluid THC > 5 ng/mL on the testing day (abstain for 48 hours)

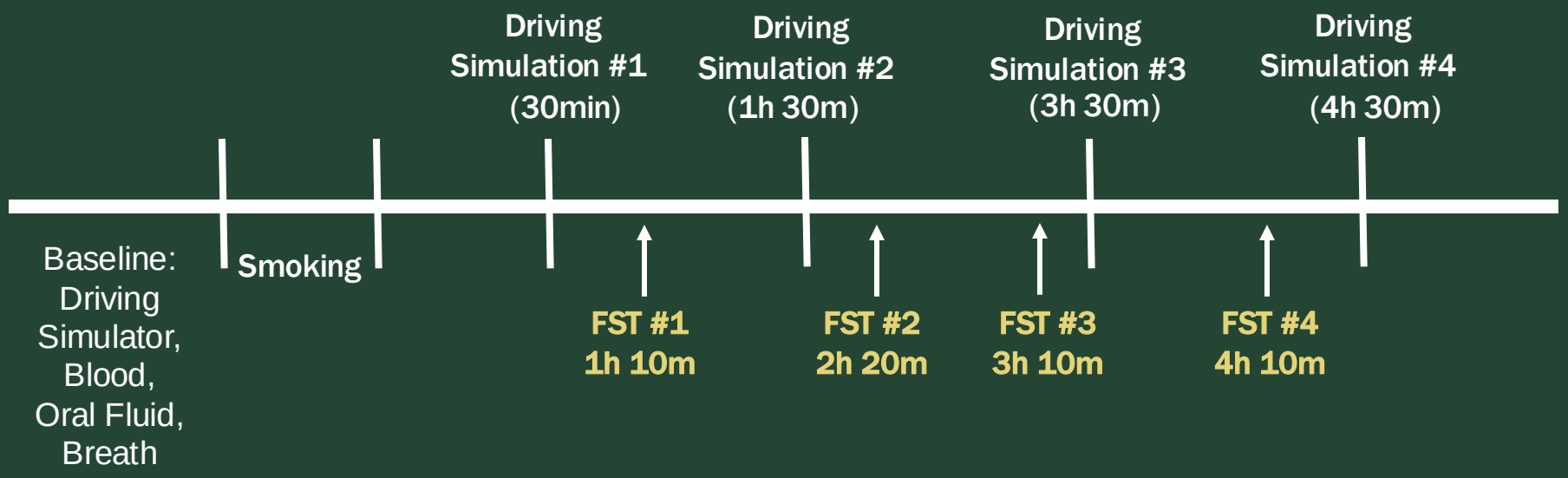
Field Sobriety Tests (FSTs)

- Clues – the participant did not perform as well as expected on a specific FST component
- Example:

Walk and Turn

- ✓ Instructions
- ✓ Balance
- ✓ Starts too soon
- ✓ Stops when walking
- ✓ Steps off line
- ✓ Wrong number of steps
- ✓ Misses heel to toe
- ✓ Raises arm to balance
- ✓ Improper turn

Study Timeline



FSTs at 1h 10min After Smoking

Significant Differences between THC and Placebo groups

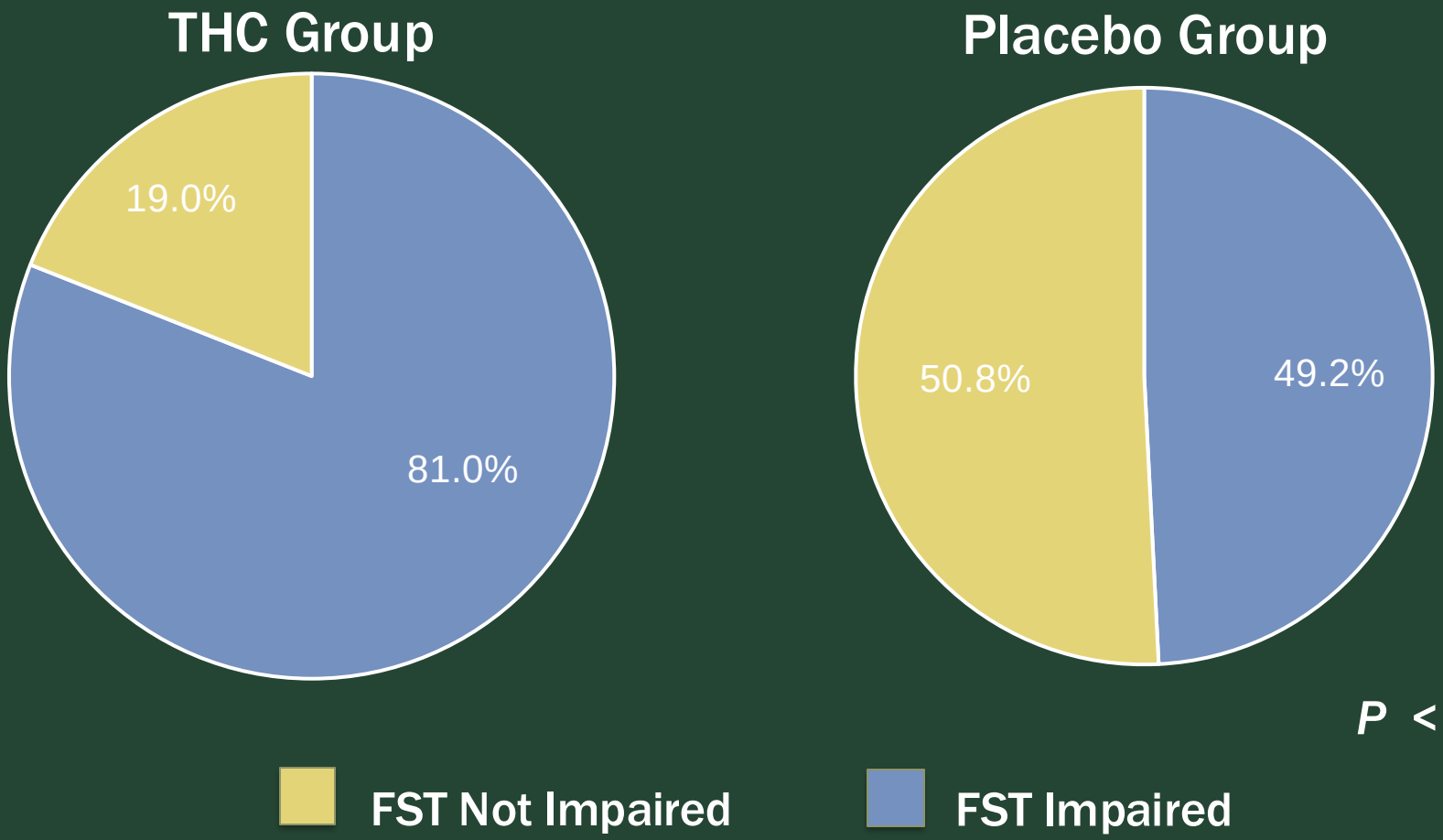
Walk and Turn	Balance, Steps off line, misses heel to toe
One Leg Stand	Puts foot down, sways
Finger to Nose	Body tremor, sways
Lack of convergence	Eyes fail to converge
Modified Romberg	None

Placebo group failed to perform adequately on many of the individual clues, ranging from 4.8% to 79.4%

Standardized Field Sobriety Tests
Cutpoints validated for alcohol

		Placebo % with ≥ 2 clues	THC % with ≥ 2 clues	Association with THC exposure OR	*p*
Walk and Turn	Total clues ≥ 2	56.5%	76.0%	2.45	0.007
One Leg Stand	Total clues ≥ 2	37.1%	58.5%	2.39	0.007
WAT and OLS	Both ≥ 2	27.9%	47.5%	2.34	0.010

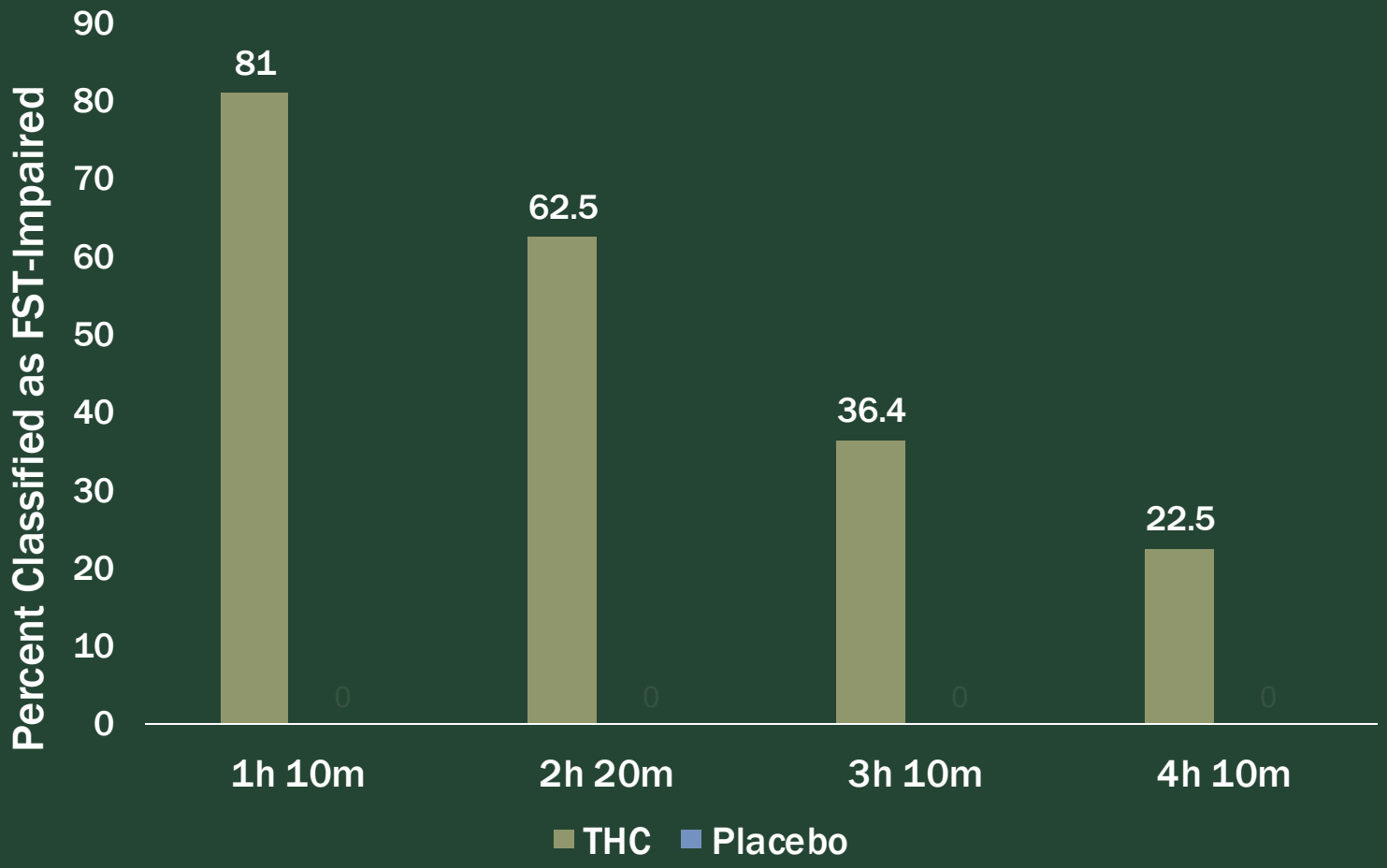
Significantly Higher FST-Impairment Rate in THC Group However, Almost Half of Placebo Group FST-Impaired



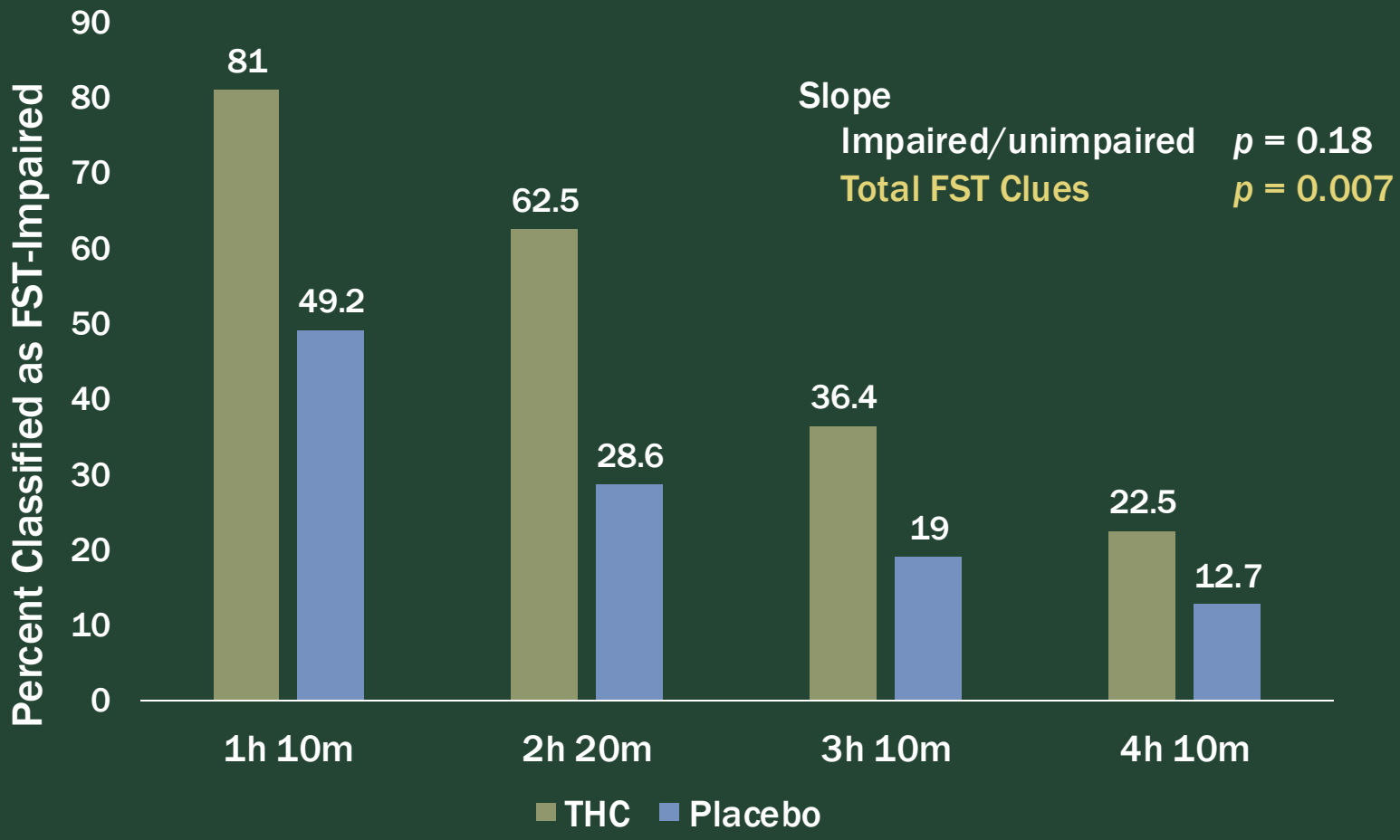
Placebo participants classified as “impaired” did not significantly differ from those classified as “not impaired”

- Demographics: age, sex, education, race/ethnicity
- Cannabis use (are these residual effects of use?)
  - Frequency of use
  - Amount of THC exposure
  - Time of abstinence prior to testing
- Medications with CNS effects
- Perception of “treatment” effects
  - Guess of treatment assignment
  - Perceived highness
- *BMI, simulator adaptation syndrome*

Officer Overall Impression
"Participant is FST-impaired"



Officer Overall Impression
"Participant is FST-impaired"



Of all FST-impaired participants (n = 128) the vast majority were believed to have received THC

	Officer Guess Regarding Treatment		
	THC	Placebo	Do Not Know
Strongly			
Somewhat			

Of all FST-impaired participants (n = 128) the vast majority were believed to have received THC

	Officer Guess Regarding Treatment		
	THC	Placebo	Do Not Know
Strongly	74.2%	0.0%	—
Somewhat	25.0%	0.0%	—
	99.2%	0.1%	—

Actual treatment	76.0%	24.0%

Study Limitations

- Officer inferred THC status without:
  - » Observation of driving behavior, interview, etc.
  - » A full DRE evaluation – additional physiological measures, etc.
- Officer examined individual participant at all timepoints
  - » First evaluation may have influenced subsequent evaluations (e.g., expectation of improvement over time)
- Only examined smoked cannabis; not highly concentrated THC products
  - » Officers may see drivers with greater impairment at roadside; may better differentiate FST impairments due to THC from non-exposure to THC
- Abstinence, and < 5ng/mL in OF, were required to enter the study
  - » Does not provide information on the effects of frequent, serial use
  - » May impact the generalizability of toxicology findings to the real world

Summary/Conclusions

- When administered by highly trained officers, FSTs differentiate between individuals receiving THC and Placebo
- However, a high proportion of non-intoxicated individuals were found to be FST-impaired
  - » FSTs are designed for high sensitivity; the cause for poor performance in this group is not clear
  - » Challenge in going from group differences to individual impairment
- Improvement in FSTs by the Placebo group suggests participants learned how to do the tests
  - » May explain the limited sensitivity and low false positive rates in previous studies

Summary

- Officers suspecting THC exposure in FST-impaired individuals (despite many being in the Placebo group) raises concerns regarding possible effects of confirmation bias
  - Officers knew participants were screened for substance use, medical, and psychiatry confounds
  - THC would be introduced as a possible cause of impairment (high base rate)
- Remains a risk in the real world

In the current study, Field Sobriety Tests, absent other indicators, are insufficient to identify THC-specific impairment in individual drivers

Future Directions

Employ varied approaches (field studies, blinded clinical trials, observational studies) to validate current practices (e.g., FSTs, full DRE evaluation)

- e.g., “Cannabis Consumption and Driving Impairment Assessment on a Closed Course” (B. Camp, CA DMV, PI)

- Examine effects of cannabis and alcohol, polysubstance use
- Develop a large blinded study to examine how a “typical” driver performs on the FSTs
  - » Law enforcement-administered FSTs
  - » Recruit non-cannabis using, non-intoxicated individuals who know they’re not possibly exposed to a substance
  - » Include a subset of individuals exposed to alcohol and/or cannabis

Accompanying Editorial
JAMA Psychiatry

The legal implication of these findings can be major given that FSTs are currently part of the evaluation protocol in North America to detect drivers who are cannabis impaired.

This leaves us with the confronting reality that current legislators can only choose between tests for detecting (recent) cannabis exposure, behavioral tests whose results inaccurately predict driving impairment, or a combination of both, even though their indication of cannabis impairment is scientifically unjustified and will be, understandably, legally challenged.

Ramaekers, et al. (2023).
High traffic – The quest for a reliable test of cannabis impairment.
JAMA Psychiatry 80(9), 871-872.

Impacting Policy and Practice

- *Transportation Research Board – annual meeting; researcher, law enforcement*
- *Society of Forensic Toxicologists – best presentation award*
- *Lifesavers Conference – national conference of traffic safety professionals, law enforcment*
- *Traffic Safety Resource Prosecutors - national webinar*
- *National Interdisciplinary Cannabis Symposium – judges, attorneys, advocates*

- *National Highway Transportation Safety Administration (key funders of law enforcement impaired driving training) - yet to meet with NHTSA; initiating their own FST/cannabis study*
- *International Association of Chiefs of Police (Technical Advisory Panel) (primary implementation of impaired driving training) – meetings to discuss aspects of finding; submissions to present to national conference have been declined*

Overall Conclusions

Important to perform on-going, robust validation of both existing and new approaches for identifying impairment to ensure *"methods and criteria for investigating drug-impaired driving are evidence-based"**

**www.theiacp.org/drugged-driving-research*

Theory-induced blindness: once you have accepted a theory and used it as a tool in your thinking, it is extraordinarily difficult to notice its flaws. If you come upon an observation that does not seem to fit the model, you assume that there must be a perfectly good explanation that you are somehow missing. You give the theory the benefit of the doubt, trusting the community of experts who have accepted it.

Kahneman, Daniel. (2012). *Thinking, Fast and Slow*

To be continued…

References

Marcotte, T. D., Umlauf, A., Grelotti, D. J., Sones, E. G., Mastropietro, K. F., Suhandynata, R. T., Huestis, M. A., Grant, I., & Fitzgerald, R. L. (2023). Evaluation of Field Sobriety Tests for Identifying Drivers Under the Influence of Cannabis: A Randomized Clinical Trial. *JAMA Psychiatry*. 2023; 80(9):914-923.

Fitzgerald, R. L., Umlauf, A., Hubbard, J. A., Hoffman, M. A., Sobolesky, P. M., Ellis, S. E., Grelotti, D. J., Suhandynata, R. T., Huestis, M. A., Grant, I., & Marcotte, T. D. (2023). Driving Under the Influence of Cannabis: Impact of Combining Toxicology Testing with Field Sobriety Tests. *Clinical Chemistry*, *69*(7), 724-733.

Marcotte, T. D., Umlauf, A., Grelotti, D. J., Sones, E. G., Sobolesky, P. M., Smith, B. E., Hoffman, M. A., Hubbard, J. A., Severson, J., Huestis, M. A., Grant, I., & Fitzgerald, R. L. (2022). Driving Performance and Cannabis Users' Perception of Safety: A Randomized Clinical Trial. *JAMA Psychiatry*, *79*(3), 201-209.

Acknowledgements

UCSD Research Team

- Thomas Marcotte, PhD
- Robert Fitzgerald, PhD
- Barth Wilsey, MD (retired)
- David Grelotti, MD
- Igor Grant, MD – CMCR Director
- Anya Umlauf, MS
- Jacqueline Hubbard, PhD
- Melissa Hoffman, PhD
- Philip Sobolesky, PhD
- Ray Suhandynata, PhD
- Breland Smith, PhD
- Emily Sones
- Sandy Sanford
- Robert Bryan
- Grace Tong-Ventura, PharmD
- Ji Sun, PharmD, PhD
- Jennifer Marquie-Beck, MPH
- Shannon Ellis, PhD

California Drug Recognition Expert Program

Marilyn Huestis, PhD - Consultant

Funded by the State of California
Assembly Bill 266 (Bonta/Cooley/Jones-Sawyer/Lackey)

Support from the
Center for Medicinal Cannabis Research at the University of California, San Diego

Driving Under the Influence of Cannabis: Evaluation of the Field Sobriety Tests

Thomas D. Marcotte, PhD

Center for Medicinal Cannabis Research (CMCR)

University of California, San Diego

UC San Diego
CENTER FOR MEDICINAL CANNABIS RESEARCH