



Recent Experimental Evidence

Thomas Arkell

Swinburne University of Technology,
Melbourne, Australia



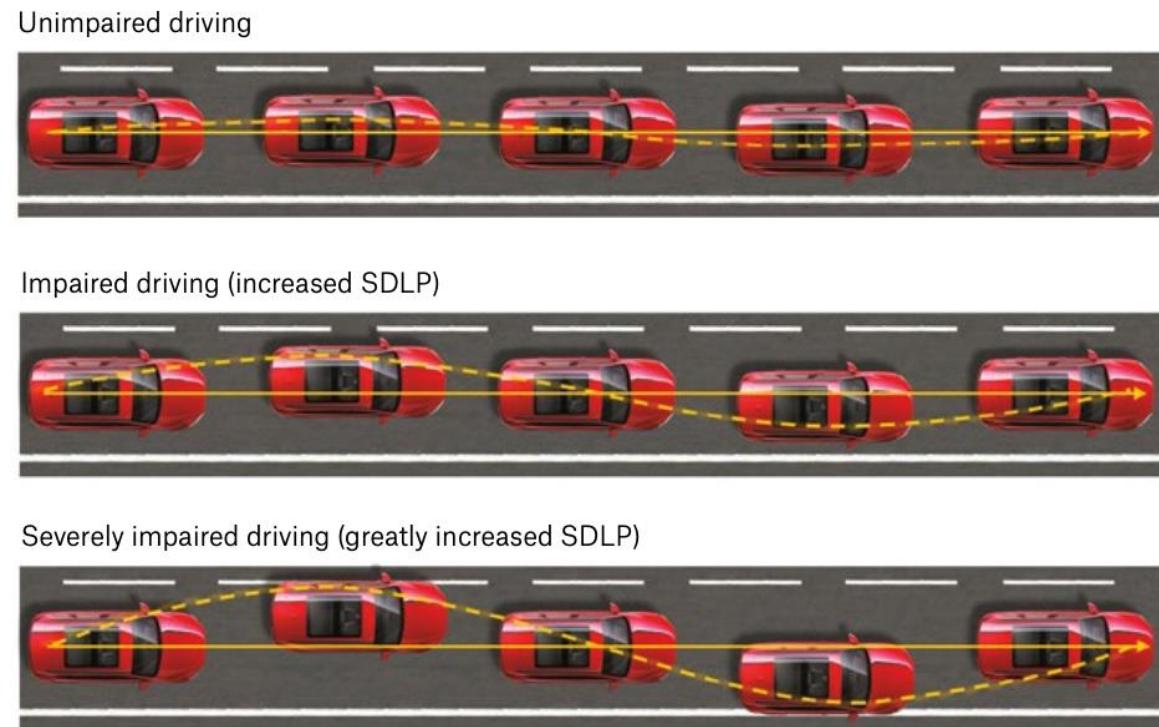
How is driving performance measured?



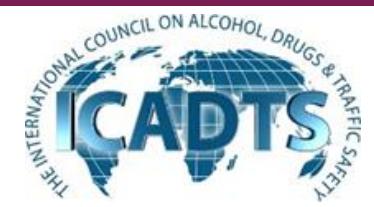
- Studies generally examine how driving performance changes under different conditions (i.e., under placebo vs active conditions)
- **On-road driving studies**
 - Most naturalistic -> highest ecological validity
 - Difficult to conduct due to logistical, ethical and financial considerations
- **Simulator driving studies**
 - Lower ecological validity
 - Greater experimental control over driving conditions (e.g., weather, traffic)
 - Can simulate scenarios that would be impossible in the real world (e.g., crash avoidance)

How is driving performance measured?

- The most common measure of driving performance is the standard deviation of lateral position (SDLP)
- The change in SDLP associated with a BAC of .05 is widely used as the benchmark for clinically relevant driving impairment
- Other common measures include reaction time, speed, and headway



Arkell, McCartney & McGregor, Reprinted from AJGP Vol. 50, No. 6, June 2021



To what extent does cannabis impair driving?

Cannabis impairs driving, although the degree of impairment it produces varies substantially depending on the dose and the individual.

To what extent does cannabis impair driving?

Effect of dose
(Robbe et al., 1998)

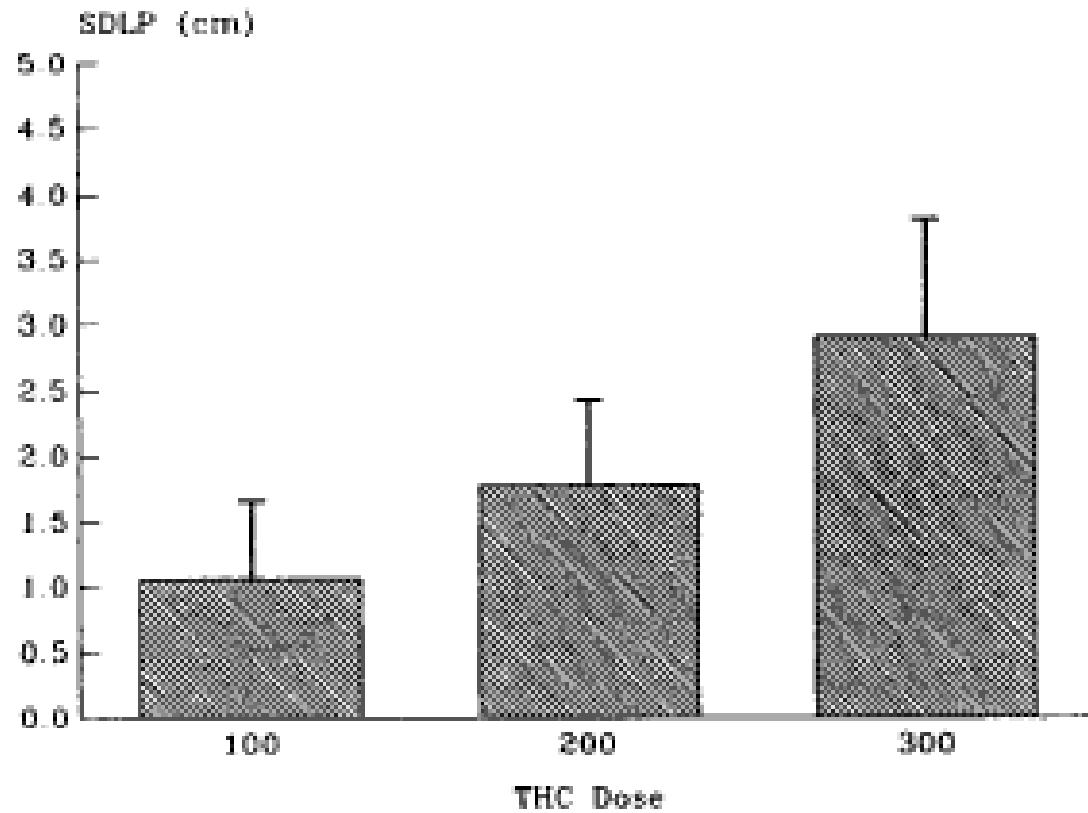
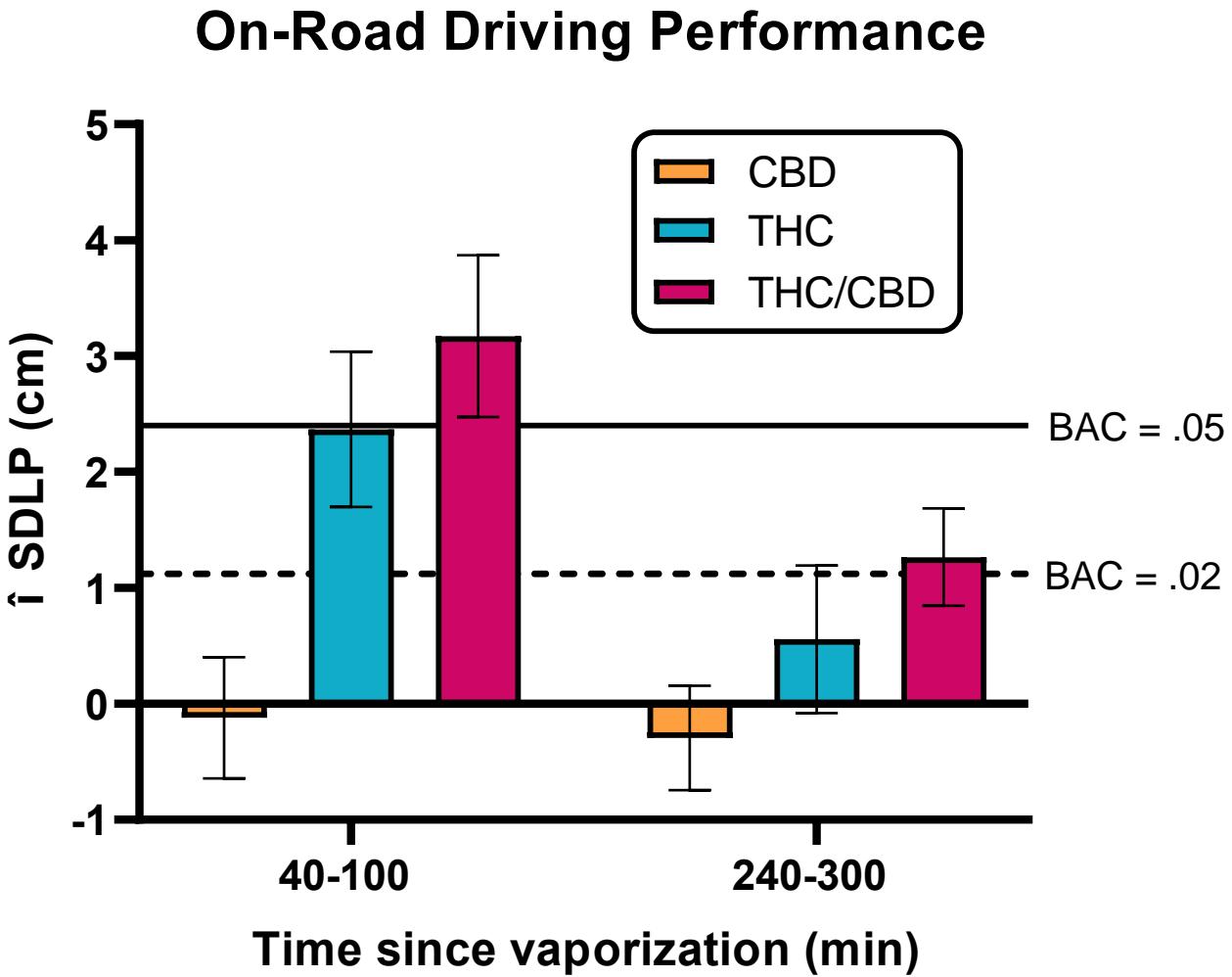


Figure 2. Mean changes (\pm SED) in SDLP in the road-tracking test by THC dose, relative to placebo

To what extent does cannabis impair driving?

Effect of time & cannabinoid composition
(Arkell et al., 2020)



To what extent does cannabis impair driving?

Effect of tolerance (Bosker et al., 2012)

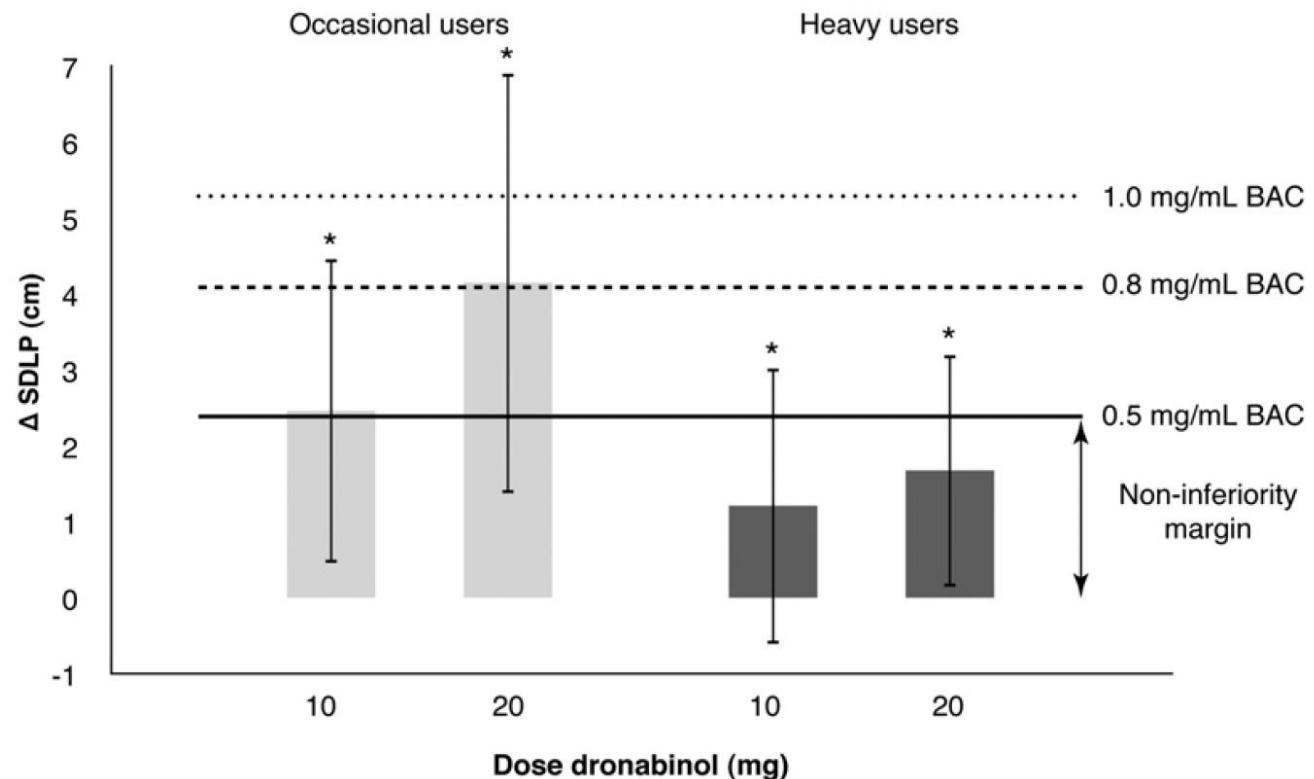
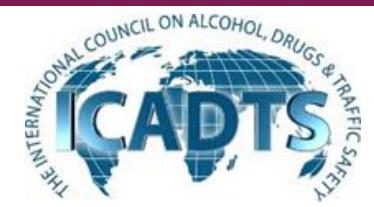


Figure 1 Mean [95% confidence interval (CI)] change in standard deviation of lateral position (SDLP) after single doses of dronabinol in occasional and heavy users.
 *Non-inferiority not shown, upper bound of the 95% CI is above the non-inferiority margin of 2.4 cm. BAC: blood alcohol concentration

To what extent does cannabis impair driving?

Other driving performance metrics

- Some studies have shown cannabis increases headway. This, like slower driving speeds, is thought to be a compensatory mechanism drivers use when they think their driving might be impaired.
- Simmons and colleagues (2022) systematic review and meta-analysis:
 - Cannabis led to slower driving speeds but nonetheless negatively affected lateral control of the vehicle (SDLP)
 - There was insufficient evidence that “cannabis reliably changes rates of crashes, hazard reaction time (RT), headway variability, time out of lane, speed variability, speed exceedances or time speeding.”

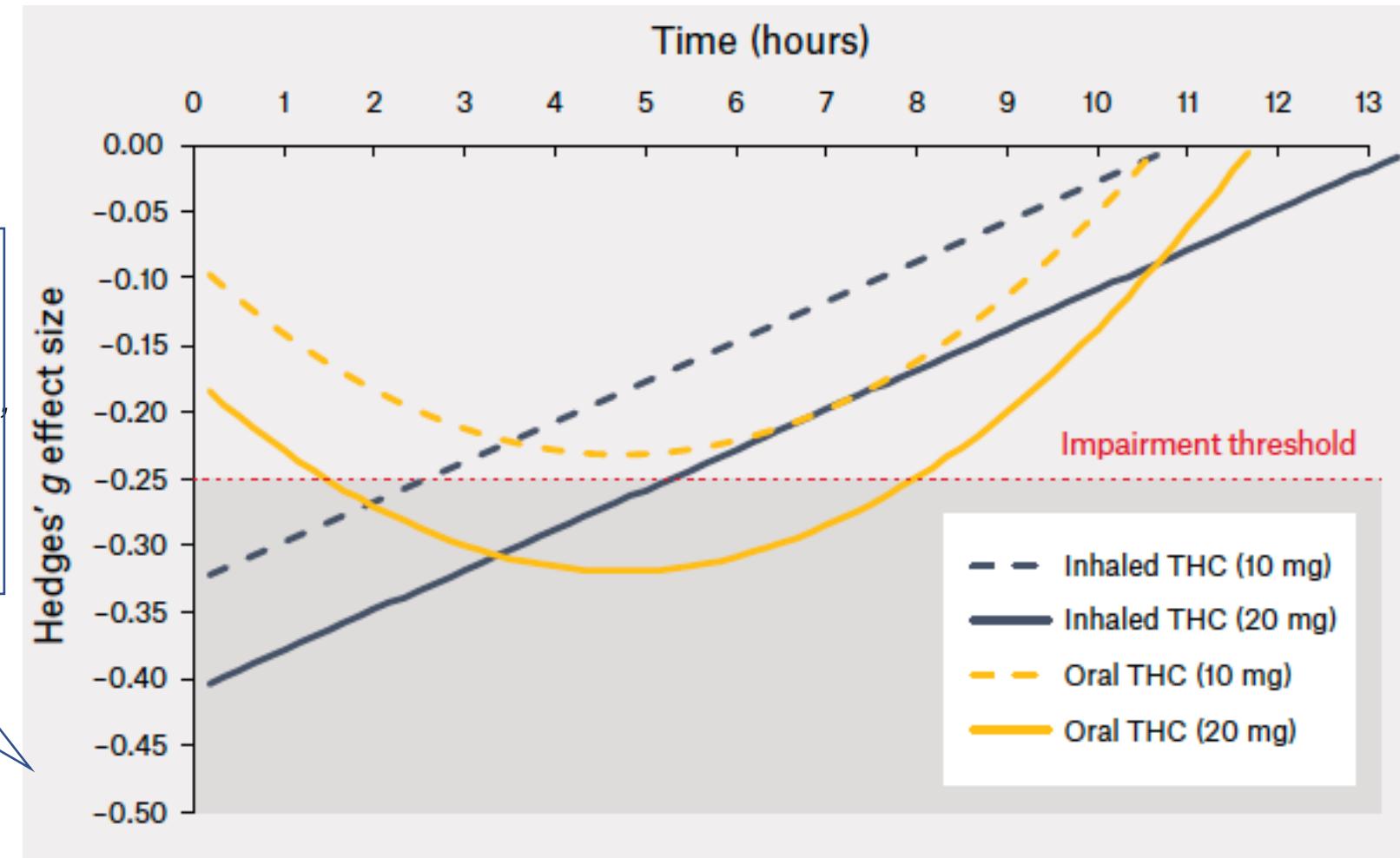


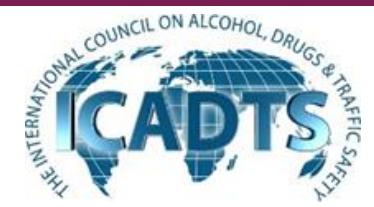
How long after using cannabis are drivers safe to drive?

The length of time needed to recover from cannabis intoxication is not fixed and depends on various factors, such as biological characteristics of consumers, type of cannabis consumed, dose, and method of ingestion.

How long after using cannabis are drivers safe to drive?

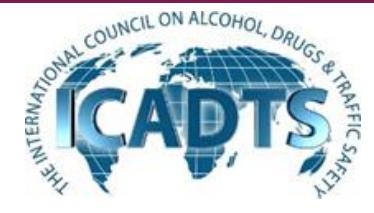
Predicted impairment time curves for occasional cannabis users by dose and route of administration. The red line represents a Hedges' g effect of -0.25 (the limit at which minimal impairment remains).





If a driver tests positive for THC, does that mean they are impaired?

No; it depends on the dose, the route of administration, and the frequency of use among individuals, as well as whether cannabis has been consumed alone or in combination with alcohol or other substances.



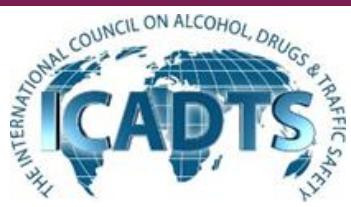
If a driver tests positive for THC, does that mean they are impaired?

There is a weak, negative correlation between THC concentration and driving performance, but at the individual level, it is impossible to reliably infer level of impairment from THC concentrations alone.

Peak THC concentrations occur *while* smoking or vaporizing and decrease rapidly after inhalation ceases. Intoxication, on the other hand, is typically greatest between 30 min and 1h after smoking.

THC can remain in the body at detectable concentrations for weeks, especially among chronic consumers.

Even with much higher doses, THC concentrations after ingestion are an order of magnitude lower than when cannabis is smoked or vaporized because of differences in the way THC is absorbed in the body.



How does cannabis compare with alcohol?

Alcohol and cannabis produce different patterns of impairing effects.

How does cannabis compare with alcohol?

- Unlike cannabis, alcohol tends to *decrease* inhibition, *inflate* self-confidence, and *increase* risk-taking behaviour, such as speeding and risky driving manoeuvres.
- Cannabis often associated with slower driving, increased headway, and a reduced willingness to drive.
- These results suggest cannabis consumers have a heightened awareness of their impairment and engage in potential compensatory mechanisms – *this does not preclude cannabis use impairing driving performance!*
- Overall, the effect of cannabis on driving is often found to be similar to low levels of alcohol (e.g., a BAC up to .05).
- Additive effects when alcohol and cannabis are combined.

What are the limitations of experimental studies of cannabis and driving?

- Studies have typically excluded older drivers, teen or novice drivers, medical cannabis consumers, individuals who are using cannabis for the first time, and heavier cannabis consumers with higher THC tolerances.
 - *Findings may not generalize well to the entirety of the cannabis-using population of drivers.*
- Participants are often self-referred (rather than randomly selected) and became unblinded to their status as individuals in either the active cannabis group or the control group which could lead to biased outcomes.

What research is still needed?

- Most experimental studies involve standard doses of THC administered with the goal of producing impairment/intoxication - much less is known about the effects of cannabis on driving in **patients using medical cannabis** in the real world and using individually tailored doses of THC or CBD.
- Further research is also needed to better understand how different doses of cannabis affect driving in **new, occasional, and chronic or frequent consumers**.
- Combined effects of THC and CBD with other **commonly prescribed medications** such as opioids, sedating antidepressants, Z-drugs, and benzodiazepines.

• • • • •

Thank you!

tarkell@swin.edu.au



Maastricht University



TRAFFIC INJURY RESEARCH FOUNDATION

