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Centre for Addiction and Mental Health

The Impact of Smoked Cannabis and Distraction on the Simulated Driving Behaviour of Young Recreational Cannabis Users



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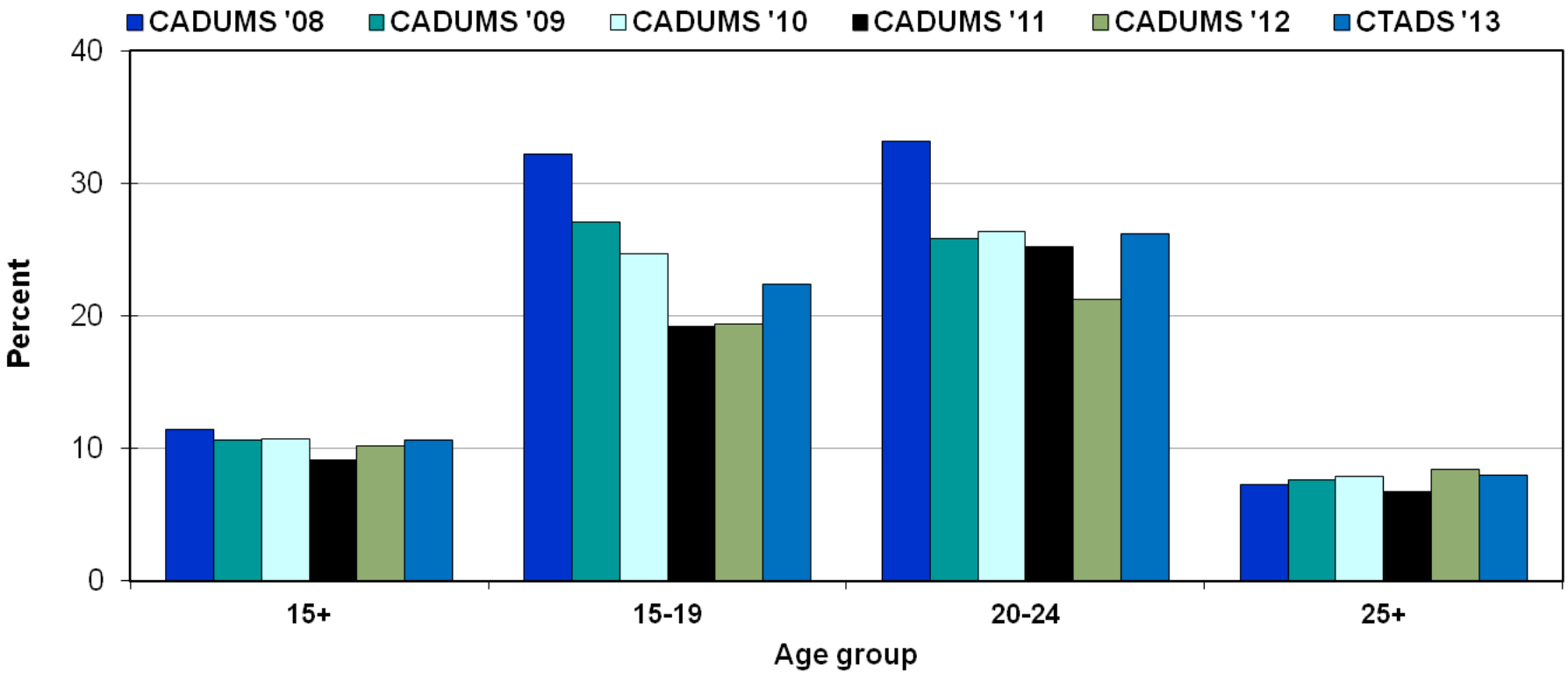
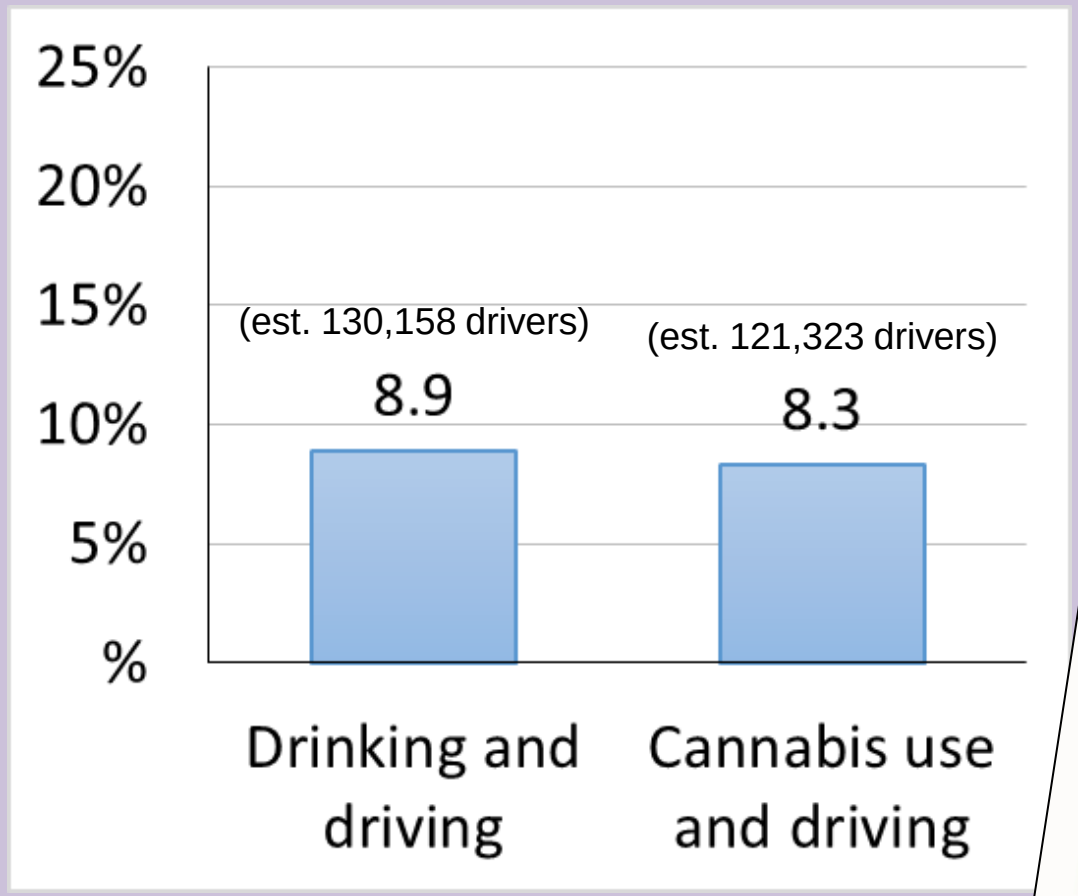
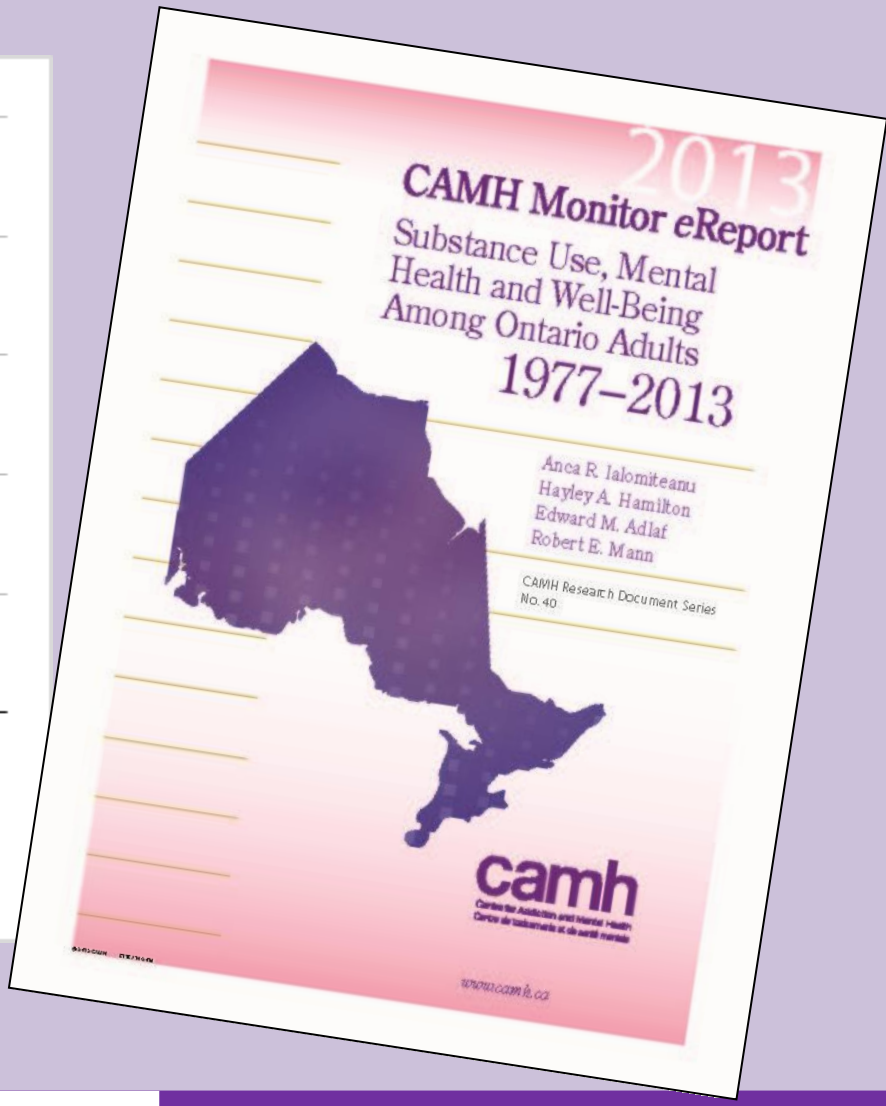
Prevalence of Past Year Cannabis Use in Canada, by Age Group, 2008-2013



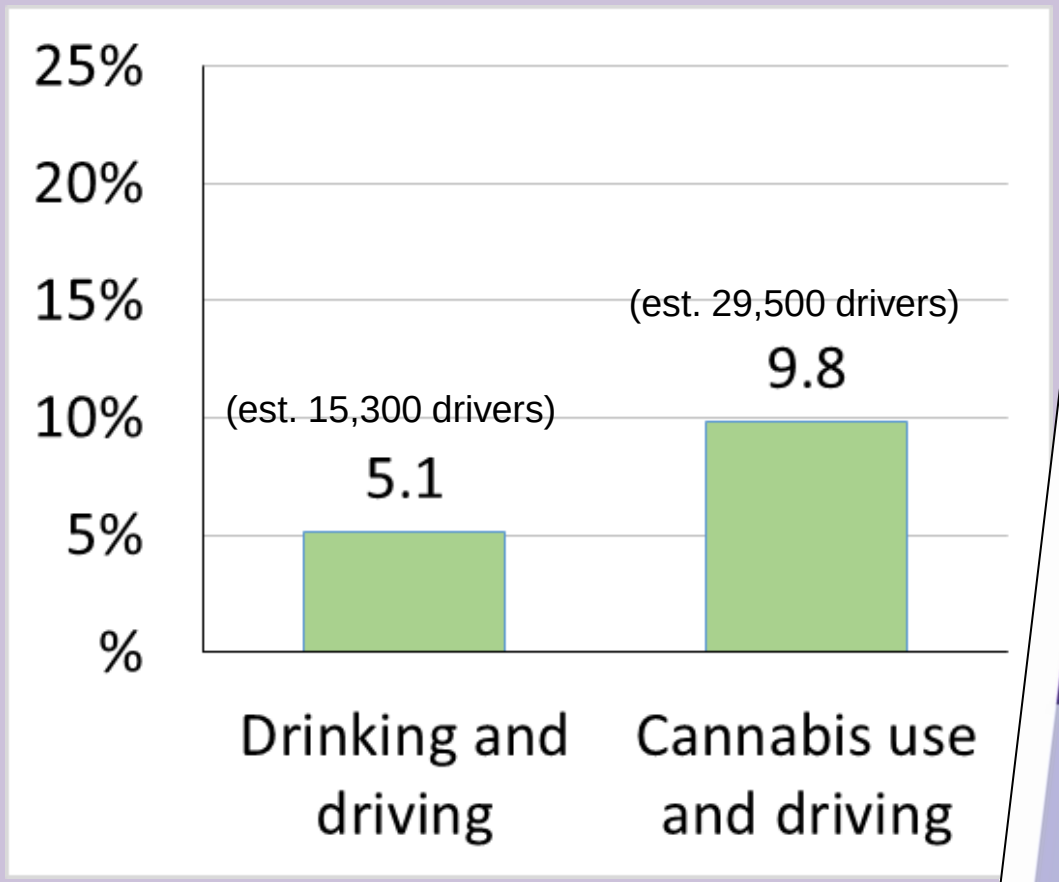
- Prevalence of cannabis use is highest amongst those aged 15 to 24 years
- Prevalence of cannabis use appears to have declined slightly from 2008 levels
- As of 2013, approximately 24% of this population reported using cannabis

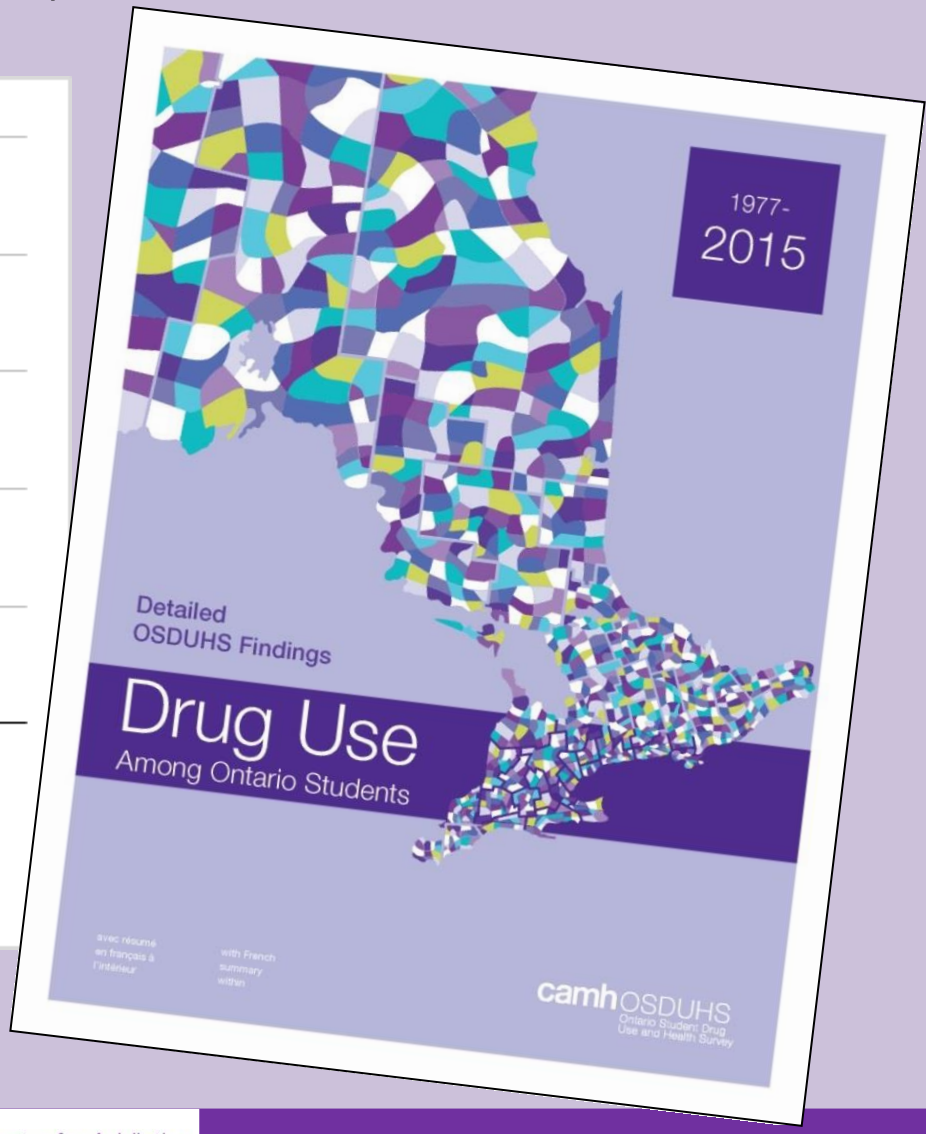
Percentage of Young Adult Drivers (Aged 18 to 29 Years) Reporting Driving a Motor Vehicle After Drinking Alcohol, and After Using Cannabis, 2013 CAMH Monitor





Percentage of Drivers in Grades 10–12 Reporting Driving a Motor Vehicle After Drinking Alcohol, and After Using Cannabis, 2015 OSDUHS





Impact of Cannabis Use on Driving

- Cannabis is the psychoactive drug most often found in seriously and fatally injured drivers after alcohol
  (Laumon et al., 2005; Stoduto et al, 1993; Woodall et al., 2015)

Feb. 1, 2011 – Jan. 31, 2012
Ontario, Canada
(Woodall et al., 2015)

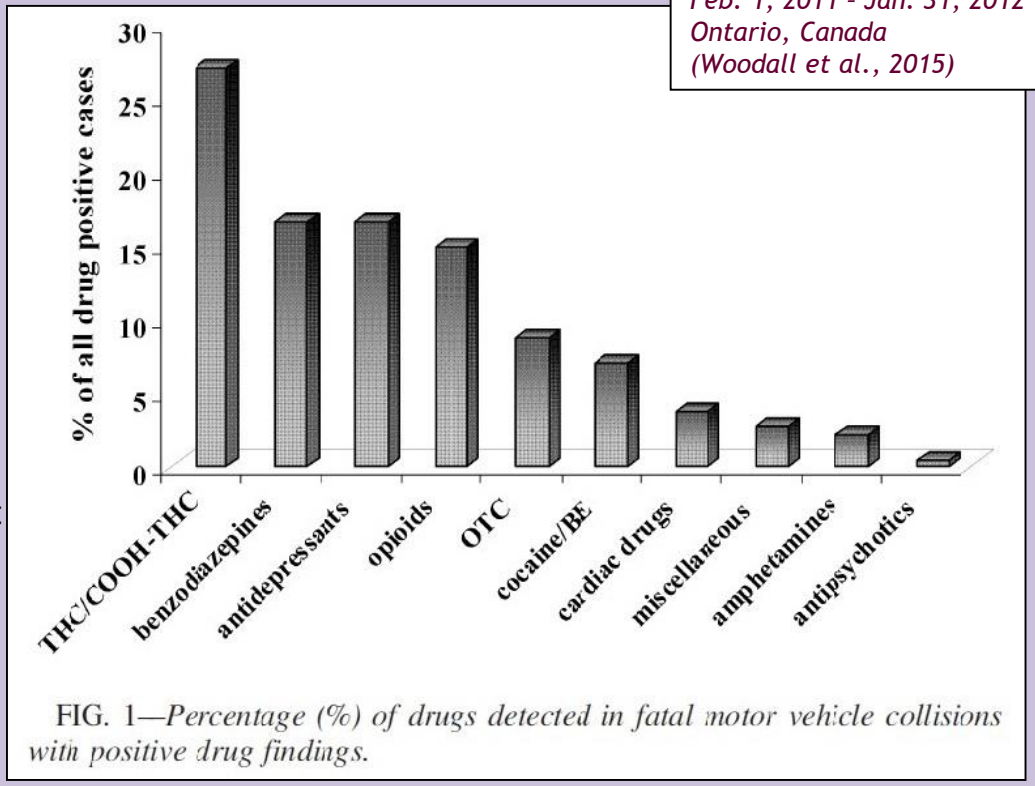


FIG. 1—*Percentage (%) of drugs detected in fatal motor vehicle collisions with positive drug findings.*

- Recent meta-analyses examining case-control and culpability studies have concluded that DUIC is associated with significant increases in collision risk (ORs=1.22 - 2.66)
  (Asbridge et al., 2012; Li et al., 2012; Rogeberg & Elvik, 2016)

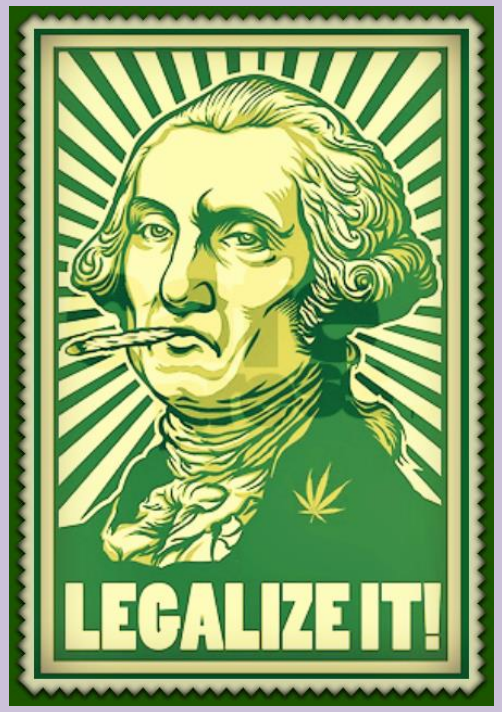
Cannabis Legalization in Other Jurisdictions

- Colorado: Legalization and commercialization of medical cannabis led to an increase in the proportion of fatally-injured drivers who were cannabis-positive

  (Salomonsen-Sautel et al., 2014)

- Washington State: Following legalization of recreational cannabis use, the prevalence of active THC and its metabolite carboxy-THC in suspected impaired driving cases increased significantly relative to the pre-legalization period

  (Couper & Peterson, 2014)



How Does Cannabis Impact Driver Behaviour? Findings from Previous Simulation Studies

- Compensatory Behaviour:
  - Drive at a slower speed
    (e.g., Hartman et al., 2016; Ronen et al., 2008, 2010)
  - Take fewer risks (e.g., larger headway, attempting fewer passes, requiring wider gaps in traffic before attempting to pass)
    (e.g., Dott, 1972; Ellingstad et al., 1973)
- Psychomotor Disturbance:
  - Increased reaction time
    (Liguori et al., 1998; Sexton et al., 2000)
- Driving Skills Deficits:
  - Reduced lane control
    (e.g., Lenné et al., 2010; Papafotiou et al., 2005; Ronen et al., 2008)
  - Decline in performance under divided attention
    (Anderson et al., 2010; Lenné et al., 2010; Ronen et al., 2008; Smiley et al., 1981)

Current Analysis

- Purpose: To examine the acute effects of a moderate dose of smoked cannabis (12.5% THC), with or without distraction, on the simulated driving behaviour of young drivers aged 19-25 years

- Study Design: double-blind, 2:1 randomized, placebo-controlled, mixed-design trial

Study Design

- Inclusion criteria:
  - Aged 19-25 years
  - Smoked 1-4 days per week
  - Held a valid Ontario class G or G2 license (held for at least 1 year)
  - Able to provide urine positive for THC at eligibility screening

- Exclusion Criteria
  - Regular user of psychoactive medication
  - Met Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) criteria for Substance Dependence, has a severe medical or psychiatric condition, family history of schizophrenia, etc.
  - Positive for alcohol on any study day

Sample Characteristics (Mean ± SD)

	Placebo	Low THC	High THC
Participants	31	32	33
Dose (mg)	N/A	70.5 ± 20.9	92.2 ± 17.0
Age	22.0 ± 2.2	22.2 ± 1.8	22.3 ± 2.0
Sex	9 females 22 males	14 females 18 males	5 females 28 males
BMI	24.8 ± 4.3	23.8 ± 4.7	25.2 ± 4.4
Cannabis smoking frequency (days/week)	2.7 ± 1.1	2.5 ± 0.9	2.6 ± 0.8
DUIC in last 30 days	2.5 ± 2.9	3.0 ± 6.6	3.1 ± 5.5

Procedures

- Study consisted of 5 sessions:
  - Session 1: Eligibility
  - Session 2: Practice Day
    - Driving, cognitive/psychomotor measures, VAS, self-report questionnaires about driving behaviour and personality
  - Session 3: Drug Administration (one 12.5% THC or placebo cannabis cigarette)
    - Ad libitum smoking procedure (max. 10 mins)
    - Pre-drug and post-drug driving tasks, cognitive/psychomotor measures, VAS, vitals and blood samples
  - Session 4: 24 Hours Measures
    - Driving tasks, cognitive/psychomotor measures, VAS, vitals and blood samples
  - Session 5: 48 Hours Measures
    - Driving tasks, cognitive/psychomotor measures, VAS, vitals and blood samples

Driving Scenarios and Instructions

- Rural two-lane highway, various interactions with other vehicles.
- Instructed to drive as they normally would – measuring behaviour not skills/abilities
- Divided Attention Task: Experimenter randomly selected a three digit number and participant was instructed to count backwards by threes (e.g., 784, 781, 778…)

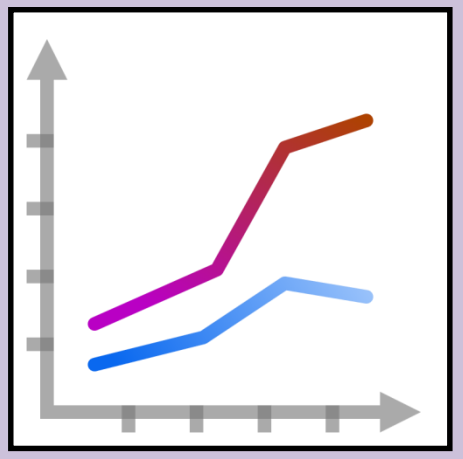
(Lansdown & Saunders, 2012; North & Hargreaves, 1999)

Driving Measures

- Global Performance Measures:
  - Mean speed and SDLP across full simulation
  - Collisions
- Event-Specific Measures:
  - Mean speed and SDLP in straightaway zone with no traffic
  - Mean speed approaching risky roadway hazard (e.g., driver standing next to vehicle stopped at side of road)
  - Following distance behind a slow-moving vehicle

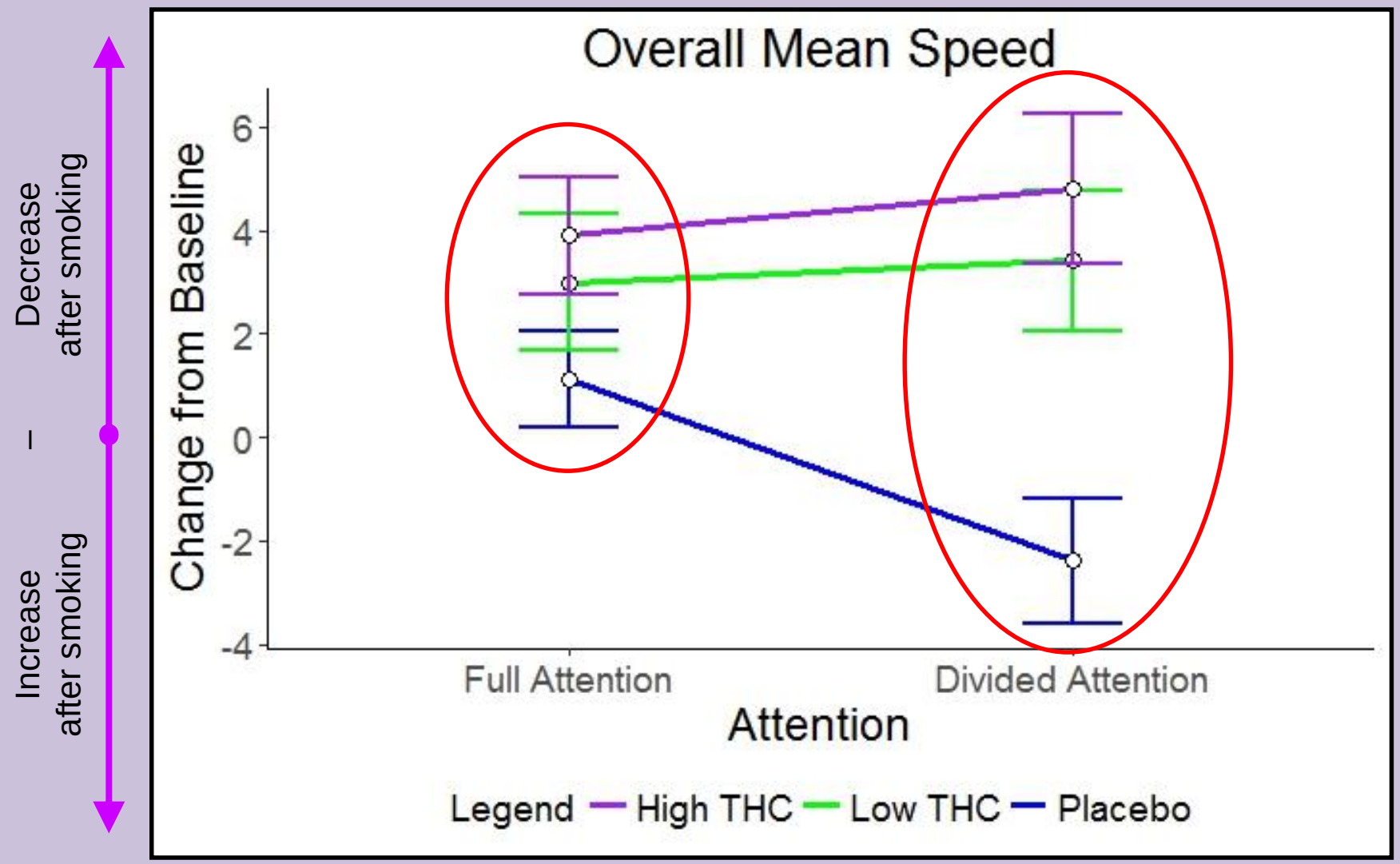
Analyses

- **These are preliminary analyses.**
- Attention x Group ANOVA framework (2 X 3)
- Change scores (Pre-Drug Measure – Post-Drug Measure)
  - Positive score = decrease in the measure after smoking
  - Negative score = increase in the measure after smoking
- Looking for interaction between Attention (counting or not counting) and Group (placebo, low THC, high THC)
- To control for violations of sphericity, a Greenhouse-Geisser correction was applied.

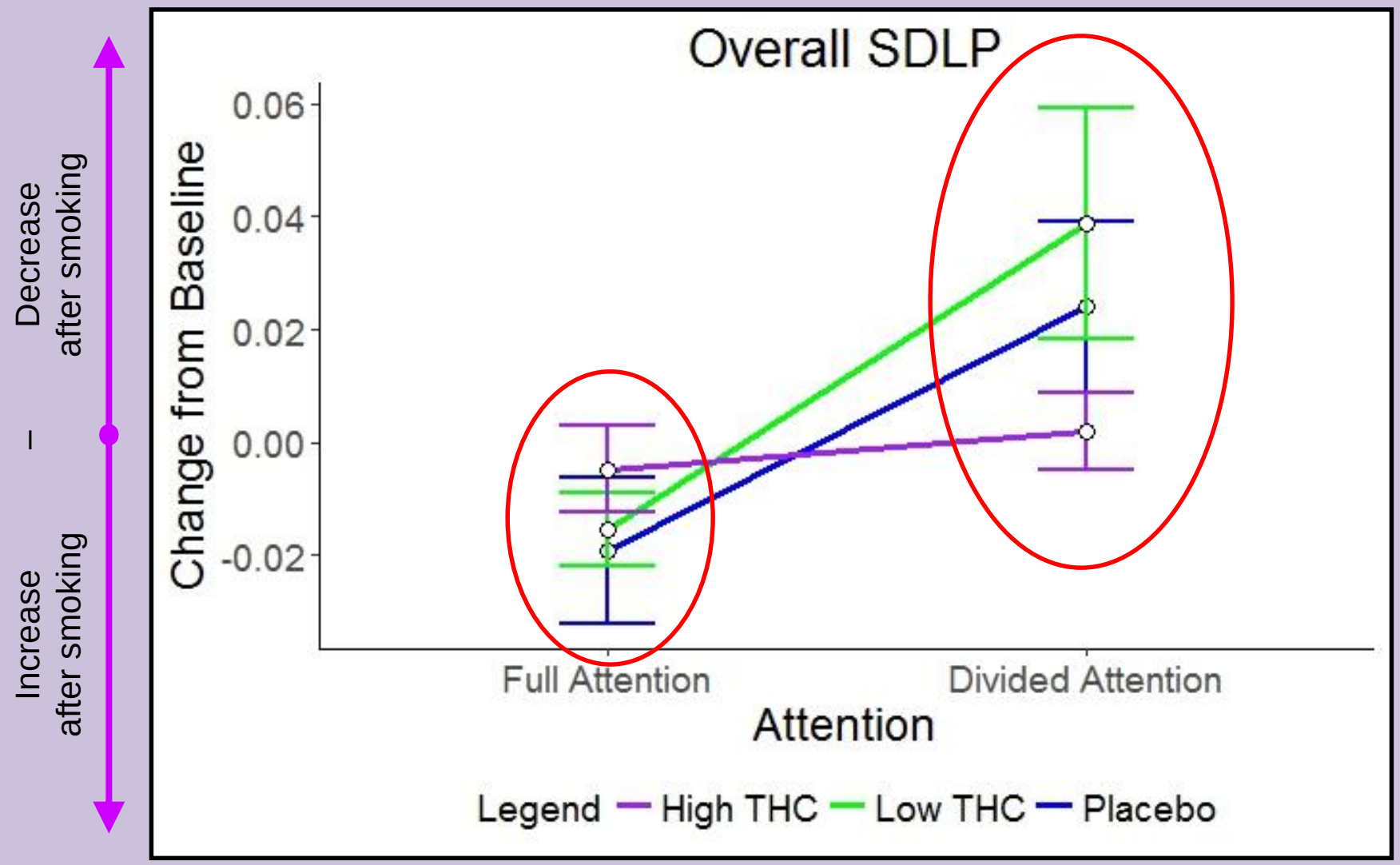


Results

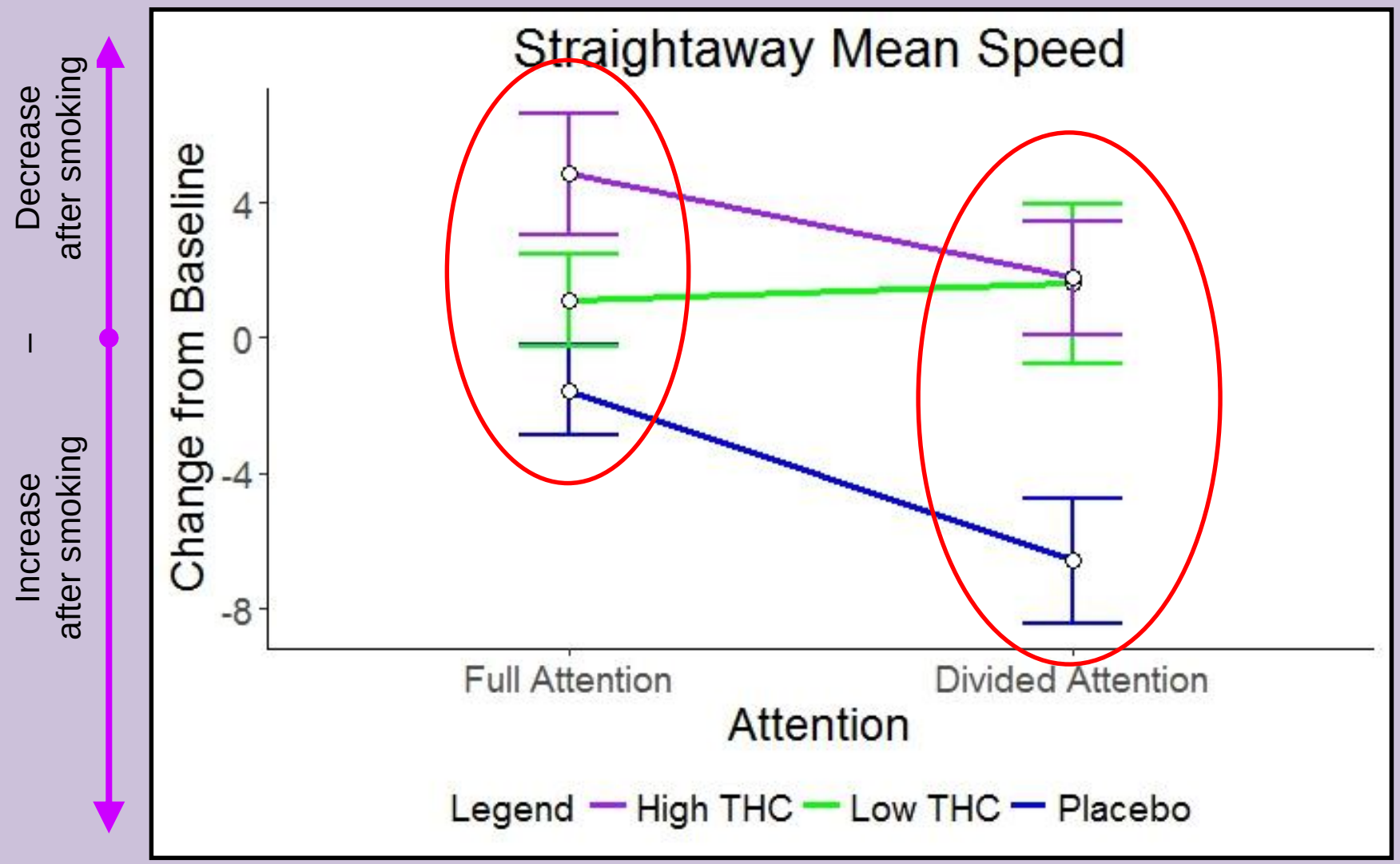
- No significant Attention x Group interaction effect for:
  - Number of collisions
  - Mean speed approaching a risky hazard
  - Following distance behind a slow-moving vehicle
- However…



Attention x Group $F(2.00,92.00) = 2.91$, $p = .06$

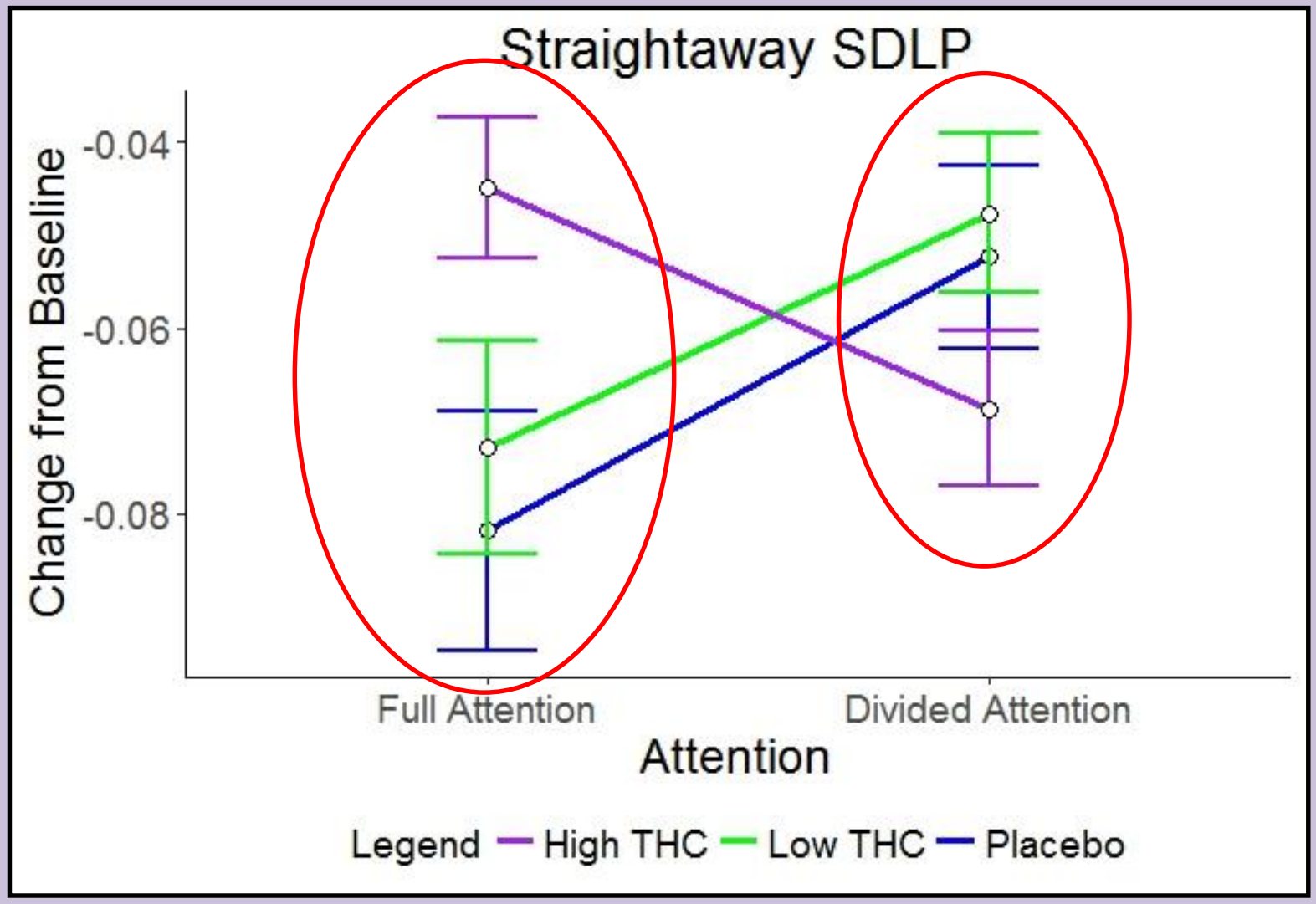


Attention x Group $F(2.00,92.00) = 2.55$, $p = .084$



Attention x Group $F(2.00,92.00) = 2.30$, $p = .106$

Increase after smoking



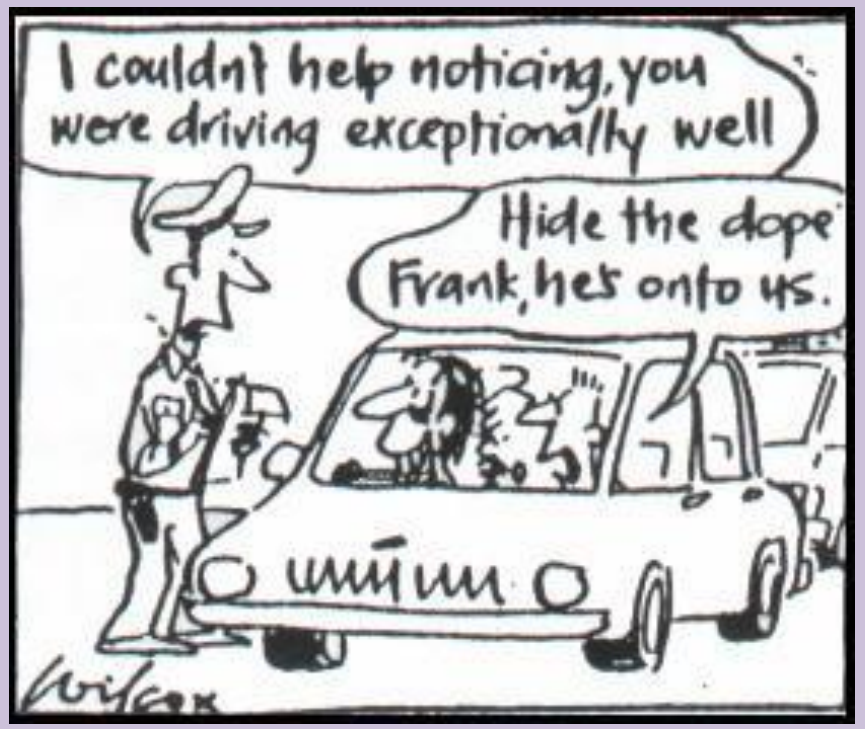
Attention x Group $F(2.00,92.00) = 6.68$, $p = .002$

Discussion

- Dose-related effects of cannabis on driver behaviour may be dependent on attention/cognitive load.
  - Dividing attention resulted in the High THC group becoming more extreme in their behaviour and setting themselves apart from Placebo and Low THC groups (SDLP).
  - Dividing attention also resulted in the Low THC group behaving more like the High THC group (Mean speed).
- Drug effects on speed and lane control appeared to be more more visible under one attention condition than another (usually divided attention).

Implications

- Compensatory behaviour when driving has been identified as an argument for why cannabis users are safer drivers when using.
- HOWEVER:
  - Predictability is an important component to a safe roadway environment.
  - When one road user's behaviour deviates from the expected norm, anxiety, stress, and anger are induced in other road users. (Wickens et al., 2005, 2013)
  - Unpredictable actions on the roadway can increase the risk of sudden and unsafe manoeuvres by other drivers (e.g., sudden braking, quick lane changes). (Aarts & van Shagen, 2006)



Limitations

- Driver simulation may not accurately reflect real-world driving.
  - However, a recent study found that simulated driving and on-road driving were comparable after consumption of oral THC, at least for measures of lane weaving

    (Veldstra, Bosker, de Waard, Ramaekers, & Brookhuis, 2015)
- High degree of variability of blood THC concentrations in the active groups.
  - A failure to see significant group differences on some measures may be due to low THC levels being achieved in the active drug group.
    - However, this was largely mitigated by the decision to split the active group into a Low and High THC group.

Future Directions

- Cannabis + Alcohol
- Dosage effects
- Tolerance effects
- Methods cannabis administration (smoking, ingestion, vaporized)
- Synthetic cannabinoids
- Detection of cannabis in oral fluid, sweat, breath, etc.
- Evaluation of the public health impact of cannabis legalization

This research was supported by a grant from the Canadian Institutes of Health Research.

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