Can alcohol intoxication goggles (Fatal Vision Goggles) be used to detect alcohol-related impairment in simulated driving?

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BACKGROUND

Drink-driving in Australia

- Alcohol intoxication implicated in ~34% of fatal motor vehicle crashes in Australia per year[1]
- Maximum legal BAC limits in Australia are 0.050%
- 12% of the population reported driving under the influence of alcohol[2]
- Researching the impact of alcohol on driving performance is important!

[1]BITRE. (2011). *Fatal Road Crashes in Australia in the 1990s and 2000s: Crash Types and Major Factors.*
[2]AIHW. (2014). *National Drug Strategy Household Survey detailed report 2013.*

BACKGROUND

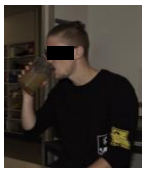
Fatal Vision Goggles (FVG)

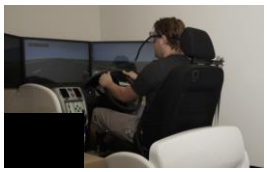
- Image distorting equipment used to simulate alcohol-related impairment
- FVG reduce favourable attitudes towards drink-driving[1,2]
- Two studies found that driving performance deteriorated when FVG were worn[3,4]

[1]Jewell, J., Hupp, S., & Luttrell, G. (2004). The Effectiveness of Fatal Vision Goggles: Disentangling Experiential Versus Onlooker Effects. *Journal of Alcohol and Drug Education*, *48*(3), 63-84.
[2]Jewell, J., & Hupp, S. (2005). Examining the effects of fatal vision goggles on changing attitudes and behaviors related to drinking and driving. *The Journal of Primary Prevention, 26*(6), 553-565.
[3]Shirazi, M. M., & Rad, A. B. (2014). Detection of intoxicated drivers using online system identification of steering behavior. *Intelligent Transportation Systems, IEEE Transactions on*, *15*(4), 1738-1747.
[4]Rumschlag, G., Palumbo, T., Martin, A., Head, D., George, R., & Commissaris, R. L. (2015). The effects of texting on driving performance in a driving simulator: The influence of driver age. *Accident Analysis and Prevention*, *74*(0), 145-149

OBJECTIVES

Aim: To determine the validity of FVG to produce alcohol-related impairment of simulated driving





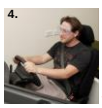
METHODS

- 22 healthy males (23±3yrs)
- placebo-controlled crossover design study
- A baseline level (BSL) simulated driving task and an experimental driving task, involving one of 5 treatments:

1. 
Alcohol beverage to elicit ~0.08% BrAC (AB)

2. 
Alcohol-placebo beverage (PB)

3. 
FVG, est. %BAC 0.07 – 0.10 (FVG)

4. 
Placebo goggles (PG)

5. 
FVG with a cognitive load task (CL)

Driving task = 3 distinct scenarios (~5 minutes each):

1. Simple driving scenario

2. Complex driving scenario

3. Hazard perception driving scenario

Lateral control:
- Standard deviation of lane position (SDLP)
- Number of lane crossings (LC)

Longitudinal control:
- Distance headway (DH)

Hazard perception measurement:
- Choice reaction time (CRT)

Breath alcohol concentration

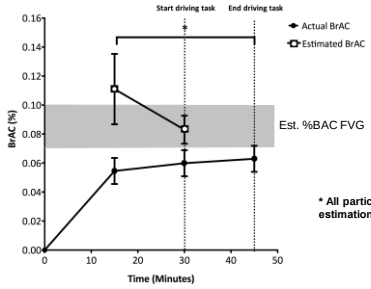
Blood glucose concentration

Urine specific gravity

Subjective ratings

FINDINGS

Breath Alcohol Concentration (BrAC) Results



*** All participants provided BrAC estimations ≥0.01% for PB trial.**

FINDINGS

Driving Simulation Results

Measurement	Δ FVG trial (ES)	Δ AB trial (ES)
Simple scenario		
SDLP (cm)	No effect	No effect
LC (*n*)	No effect	No effect
Complex scenario		
SDLP (cm)	↑ 3.3 (0.48)	↑ 2.7 (0.33)
LC (*n*)	↑ 2.2 (0.48)	↑ 2.5 (0.47)
DH (m)	↓ 7.8 (0.47)	↓ 6.2 (0.35)
Hazard perception scenario		
CRT (sec)	No effect	↑ 0.04 (0.26)

Significant change ($p<0.05$)

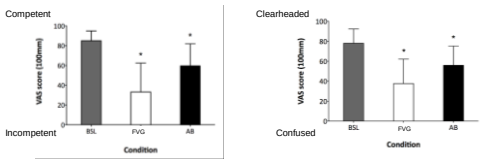
Non- significant change ($p<0.10$)

Δ = Difference compared to baseline driving performance
ES = Cohen's d effect size

* Neither placebo treatment affected driving performance

FINDINGS

Subjective Results: Mood Ratings



Similar trends were observed for ratings of alertness and coordination

* Neither placebo treatment affected mood ratings

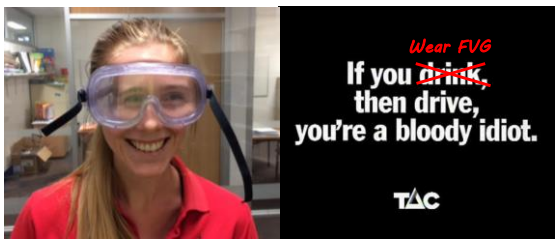
CONCLUSION

FVG appear to have some utility in replicating alcohol-related impairment on specific driving performance measurements AND appear to influence other elements of perception in a similar manner to alcohol intoxication

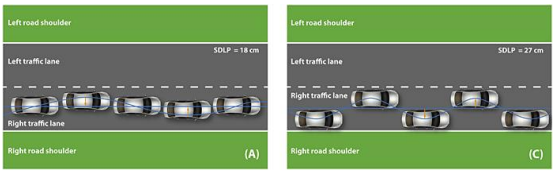
Potential applications:

- Drink-driving education programs
- Could replace the need to have participants consume alcohol in research studies prior to using a driving simulator

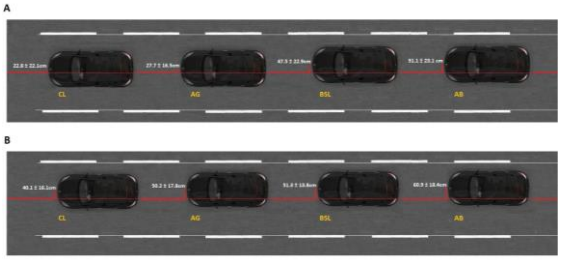
QUESTIONS?



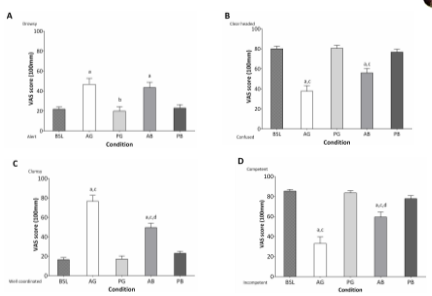
Standard deviation of lane position (SDLP):



Verster, J. C., & Roth, T. (2014). Excursions out-of-lane versus standard deviation of lateral position as outcome measure of the on-the-road driving test. *Human Psychopharmacology: Clinical and Experimental, 29*(4), 322-329.



	AG trial		PG trial		AB trial		PB trial		CL trial	
	BSL	AG	BSL	PG	BSL	AB	BSL	PB	BSL	CL
Simple Driving Scenario										
SDLP (cm)	21.7 (6.12)	22.6 (5.4)	19.7 (4.23)	21.8 (6.10)	23.2 (7.31)	22.4 (6.02)	22.1 (5.00)	21.1 (5.39)	21.5 (6.34)	20.9 (8.43)
LC (total number)	0.86 (2.14)	0.18 (0.59)	0.76 (2.84)	1.00 (3.07)	2.32 (5.60)	1.59 (3.19)	1.73 (3.62)	1.36 (2.85)	0.76 (1.95)	0.67 (1.93)
LP (-) (cm)	47.4 (20.4)	27.7 (16.5)*	47.4 (21.7)	46.8 (20.2)	49.1 (23.8)	51.1 (23.1)	47.1 (24.3)	50.4 (18.7)	46.7 (24.3)	22.8 (22.1)*
SDSP (km/hr)	2.24 (0.57)	2.77 (0.96)*	2.41 (1.00)	2.45 (0.84)	2.54 (0.98)	2.37 (0.82)	2.21 (0.74)	2.16 (0.69)	2.20 (0.76)	3.56 (1.50)*
SP (km/hr)	79.2 (1.70)	79.4 (2.90)	79.3 (1.64)	78.7 (1.61)	79.5 (1.63)	79.4 (1.60)	79.3 (1.13)	79.1 (1.01)	79.2 (1.10)	79.2 (4.00)
Complex Driving Scenario										
SDLP (cm)	25.2 (6.67)	28.5 (7.00)*	25.1 (7.04)	26.5 (6.54)	26.0 (7.90)	28.7 (8.23)*	25.3 (7.90)	25.4 (7.45)	24.4 (6.33)	26.9 (8.90)*
LC (total number)	1.18 (2.11)	3.36 (6.11)	1.77 (3.19)	2.09 (2.58)	2.00 (3.27)	4.45 (6.65)*	1.91 (2.35)	2.09 (2.80)	1.52 (3.03)	2.95 (6.55)
LP (-) (cm)	50.3 (13.6)	50.2 (17.8)	50.6 (12.3)	52.9 (15.5)	51.3 (16.9)	60.9 (18.4)*	52.5 (13.3)	52.5 (16.6)	52.0 (13.1)	41.0 (16.1)*
DH (m)	55.3 (16.0)	47.5 (17.0)*	62.7 (21.0)	59.2 (14.3)	59.0 (17.6)	52.8 (17.6)	56.9 (19.5)	59.5 (20.1)	55.3 (16.0)	72.1 (38.5)
Min. DH (m)	34.4 (8.36)	30.0 (10.4)*	35.9 (9.55)	37.8 (7.75)	38.3 (7.15)	36.2 (7.79)	37.0 (7.43)	37.0 (7.83)	35.6 (6.64)	31.4 (9.35)*
Hazard Perception Driving Scenario										
CRT (sec)	0.89 (0.12)	0.89 (0.13)	0.87 (0.15)	0.87 (0.14)	0.88 (0.14)	0.92 (0.14)	0.87 (0.14)	0.86 (0.15)	0.88 (0.15)	1.09 (0.17)*



'b' denotes a significant difference from active treatments (AG and AB); 'c' denotes a significant difference placebo treatments (PG and PB) and 'd' denotes a significant difference from the AG treatment. Values are mean ± SEM.