Acute Alcohol Effects on Mesopic Rod and Cone Temporal Processing

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Background

Studying acute alcohol effects on rod and cone function is important for prevention of alcohol-related accidents/injuries. It can also help to understand why alcohol drinking may increase risk for some retinal diseases. For instance,

Heavy alcohol drinking has been shown to be a potential risk factor for AMD (Klein et al., 2002), while moderate drinking may reduce the odds of developing AMD (Obisesan et al., 1998).

However, literature reports on alcohol effect on rod and cone function are mixed. For instance,

Alcohol reduced photopic CFFs but not mesopic CFFs (Pearson & Tinney, 1999). They interpreted the results as a selective alcohol impairment on cone function.

Alcohol reduced dark-adapted ERG b-wave amplitude, suggesting alcohol also impaired rod function (Ikeda, 1963).

Purpose

• To measure the acute effect of drinking a high dose of alcohol on mesopic rod and cone critical fusion frequency (CFF).

• To explore the association between acute alcohol impairment on photoreceptor function and recent drinking patterns.

Design

Breath Alcohol Concentration (BrAC)

Dark Adaptation
(Right Eye only)

Snack Questionnaire
(30 minutes)

Pre-Beverage CFF
(5-10 min.)

Beverage Intakes
(Placebo or Alcohol, 0.8 g/kg)
(15 minutes)

Rest
(45 min)

Post-Beverage CFF
(5-10 min.)

16 Observers: age 27.1±5.6 yrs; 9 males

CFF Stimuli & Procedure

Four-primary photostimulator to control stimulation of the rod and 3 cone types independently.

• Sinusoidal modulations in a 1-sec raised cosine envelope.

• Modulation types: isolated rod (R), isolated cone luminance (L+M).

• Modulation contrast: 35%.

• Retinal Illuminance: 80 Td.

Observer adjusted temporal frequency to determine CFF (six trials/condition).

Alcohol vs. Placebo Effects

Compared with placebo, alcohol significantly reduced rod and cone CFFs.

p = 0.02

p < 0.001
Past-Month Drinking (Timeline Followback)

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<th>Avg. Number of drinks on drinking days</th>
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* Binge = 5+drinks/episode for men; 4+drinks/episode for women

Drinking Frequency and Quantity
- Number of drinking days
- Number of drinks on drinking days
- Number of binging days
- Max Number of drinks on any drinking days

Drinking Severity Score
One factor (93% of variance explained)

Another way to see this data is through alcohol impairment in CFF (Alcohol Post-Pre – Placebo Post-Pre)

Cone Impairment

Impairment at Alcohol Effects on CFF (Alcohol-Placebo)

ACFF = 0.408 + 0.102D - 2.452D^2 + 0.417D^3

Where D = Drinking Severity Score
**Cone Impairment**

- Light Drinkers
- Moderate/Heavy Drinkers

$r = 0.76, p = 0.078$

**Rod Impairment**

- Light Drinkers
- Moderate/Heavy Drinkers

$r = 0.050, p = 0.92$

$r = 0.36, p = 0.385$

**Summary**

- An intoxicating dose of alcohol acutely impaired both rod and cone temporal processing.
- Non-linear relation between alcohol impairment on cone CFF and drinking severity:
  - Moderate/Heavy Drinkers: heavier drinking -> more alcohol impairment
  - Light Drinkers: heavier drinking -> less alcohol impairment
- Non-definitive association between alcohol impairment on rod CFF and drinking severity.

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**References**