



Neural Dynamics of Alcohol Effects on Response Conflict

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367.17

INTRODUCTION

Recent theories have proposed that the conflict detection and error monitoring are subserved by interplay between the lateral prefrontal and the anterior cingulate cortices [1], but the evidence of alcohol's effects on the neural systems underlying inhibitory control is scant. The purpose of this study was to identify effects of moderate alcohol intoxication on the spatiotemporal characteristics of these distributed neural systems during a color version of the flanker task, using an anatomically-constrained MEG (aMEG) method [2, 3].

METHODS

Healthy subjects (N=18, 8 women) participated in placebo and alcohol conditions (0.6g/kg for men, 0.55 g/kg women). In a color-version of the Eriksen flanker task (ref) they used one of two buttons to respond to the central colored box (one of 4 colors), surrounded by flankers

Stimulus sequence: **Button presses:**

-Stimulus Incongruent (SI) (25% trials)
 Target differs from flankers in color, but same response button

-Response Incongruent (RI) (25% trials)
 Target differs from flankers in color and response button mapping

-Congruent (CO) (50%)
 Target is the same color as the flankers

Stimuli (512 total) were presented for 200ms (flankers), 200ms (flankers + targets) every 1.6 sec.

In addition to the overall analysis above, the trials were ordered so as to permit investigation of the effects of:

Negative Priming:

Is slower/less accurate responding to a recently ignored stimulus (i.e. to a target color that was a flanker color on the previous trial).

Negatively Primed trials: (NP)

Flanker color becomes the target color on the next trial

Unprimed trials (UP)

Flanker color is unrelated to the subsequent target color

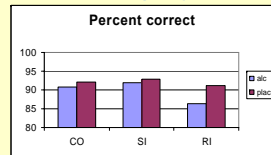
Anatomically-constrained MEG (aMEG) [2, 3]:

Please see the accompanying poster 367.16 for details on aMEG acquisition and analysis, as well as structural MRI acquisition protocol.

BEHAVIORAL RESULTS

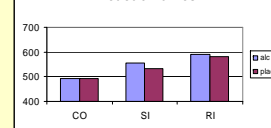
Presented for N=13 (6 females)

Effects of Congruity



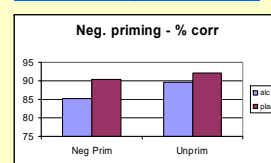
-alcohol decreased accuracy on the response incongruous trials

Reaction times



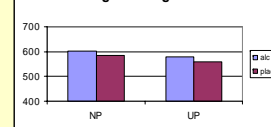
- RTs unaffected by alcohol, but increase linearly with the degree of incongruity

Effects of Negative Priming



- Alcohol decreased accuracy on negatively primed trials

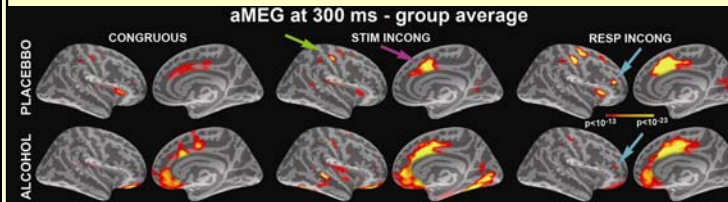
Neg. Priming - RTs



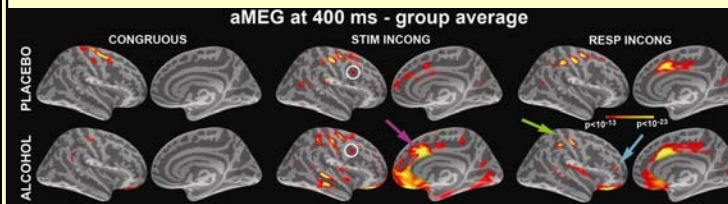
- RTs were unaffected by alcohol, but were longer on negatively primed trials

aMEG RESULTS - CONGRUITY

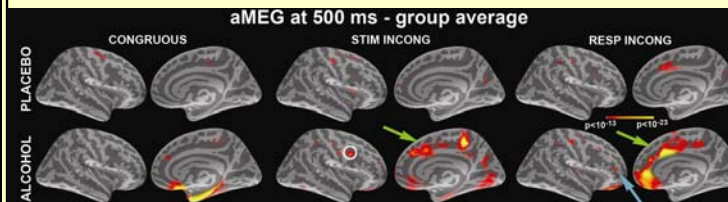
Group average estimates (N=9) at 300, 400, 500ms.



Under placebo, activity in motor/ premotor areas (\Rightarrow), dorsal medial prefrontal (\Rightarrow), and anterior inferior prefrontal AIP (\Rightarrow) areas increases with the degree of incongruence. Alcohol decreased the activity in motor/premotor and inferior prefrontal areas, but increased activity in both dorsal and ventral cingulate regions, indicating engagement of both cognitive arousal circuits

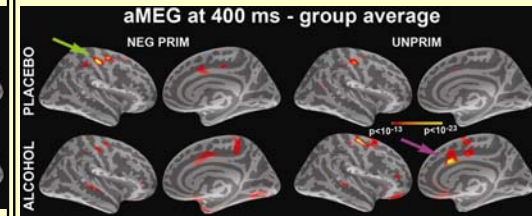


Under placebo, the motor/premotor, as well as dACC activity is dependent on the degree of incongruence. Under alcohol, activity decreased in the motor/premotor areas (\Rightarrow), but increased in dorsal and ventral cingulate regions on high-conflict trials only (\Rightarrow). In addition, activity increased in the AIP (\Rightarrow) and inferior frontal junction (white circle).



Alcohol-induced activity in the medial prefrontal area (\Rightarrow) as well AIP (\Rightarrow) and the inferior frontal junction (white circle) continues during the performance monitoring stage.

NEGATIVE PRIMING



Motor/premotor activity increased on the negatively primed trials during response preparation (\Rightarrow). Unlike the unprimed trials, there was no compensatory engagement of the medial prefrontal region, resulting in lower accuracy.

CONCLUSIONS

- Alcohol lowered attentional control on the response-incongruous and negatively primed trials
- Activity in the extended motor (eMA) and medial prefrontal region (dACC) increased with the degree of incongruence
- Alcohol increased ACC activity dorsoventrally on the incongruent trials reflecting both – response selection/preparation and arousal engagement
- Its sustained contribution indicates its role in performance monitoring
- Concomitant increase in the anterior prefrontal area and the inferior frontal junction may indicate response adjustments [4]
- Similar activity was observed on the negatively primed trials, but absence of alcohol-induced compensatory dACC increase may have resulted in lower accuracy

1. Carter CS, et al., (1998) Anterior cingulate cortex, error detection, and the online monitoring of performance. *Science* 280(5364):747-9
2. Dale et al.(2000). Dynamic statistical parametric mapping: Combining fMRI and MEG for high-resolution imaging of cortical activity. *Neuron* 26:55-67.
3. Marinkovic, (2004). Spatiotemporal dynamics of word processing in the human cortex. *Neuroscientist*. 10:142-152.
4. Brass, M. et al., (2005) The role of the inferior frontal junction area in cognitive control. *TICS*. 9:314-316

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