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Short Communication

Effects of heavy drinking on executive cognitive functioning in a community sample

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HIGHLIGHTS

- Individuals with greater alcohol consumption exhibited more ECF impairments.
- These results remained after controlling for demographics including drug use.
- These findings extend evidence of ECF impairment associated with heavy drinking.

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ABSTRACT

Background: Deficits in several aspects of executive cognitive functioning (ECF) have been consistently associated with alcohol use disorders. Most of this research, however, has been conducted in alcohol dependent patient samples. A handful of recent studies, primarily in college students, have also reported similar deficits, but little is known about the effects of heavy drinking in adult, non-patient men and women.
Methods: A community sample (N = 560) of men and women completed a brief battery of ECF measures including measures of attentional control, cognitive flexibility, working memory and response inhibition. Quantity/frequency of alcohol and illicit drug use in the past year were also assessed.
Results: Regression analyses indicated that men and women with higher levels of alcohol consumption exhibited greater impairment on several ECF measures, primarily those pertaining to cognitive flexibility and response inhibition. These results remained after controlling for demographic factors such as age, gender, education, and illicit drug use.
Conclusions: These findings support and extend prior work documenting the deleterious effects of heavy alcohol consumption on ECF in a community sample and specifically indicate robust effects on cognitive flexibility, psychomotor speed, and response inhibition.

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1. Introduction

Executive cognitive functioning (ECF) is a complex construct involving several neurocognitive domains such as response inhibition, cognitive flexibility, and working memory (Anderson, Jacobs, & Anderson, 2008). Individuals with alcohol use disorders (AUDs) demonstrate ECF impairments (see Uekermann & Daum, 2007 for review) as well as damage to the frontal brain (Oscar-Berman & Marinković, 2007; Sullivan, Harris, & Pfefferbaum, 2010). Most studies of ECF and AUD have focused on alcohol patient/treatment samples for which impairments are pronounced and related to the history of alcohol consumption (Du, Guo, & Jiang, 2002). Accordingly, the value of gaining a better understanding of neurocognitive deficits with regard to AUD treatment implementation (Blume & Marlatt, 2009), prognosis (Schrimsher & Parker, 2008) and non-treatment factors such as quality of life and interpersonal relationships (Sherman, Slick, & Eyrl, 2006; Vohs, Lasaleta, & Fennis, 2009) has been repeatedly demonstrated.

Evidence suggests that subclinical levels of heavy/binge drinking also result in ECF deficits that have a significant impact on daily life. Alcohol consumption/problems can result in ECF impairment in planning, working memory, and cognitive flexibility (Blume, Marlatt, & Schmaling, 2000; Giancola, Zeichner, Yarnell, & Dickson, 1996; Sher, Martin, Wood, & Rutledge, 1997). Studies comparing binge/heavy drinkers to light drinkers or abstainers report similar effects (Hartley, Elsabagh, & File, 2004; Meyerhoff et al., 2004). These findings provide evidence of alcohol-related ECF deficits in actively drinking, non-clinical samples, but are primarily limited to college students whose drinking patterns may be atypical compared to later adulthood. Given the potential for recovery of functioning (De Sousa Uva et al., 2010; Mann, Günther, Stetter, & Ackermann, 1999) when heavy drinking

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stops (e.g., after college; Schulenberg, O'Malley, Bachman, Wadsworth, & Johnston, 1996; Tucker, Orlando, & Ellickson, 2003), it would be informative to examine the effects of binge drinking in an older, non-clinical sample.

The current study was designed to examine ECF in relation to alcohol consumption in a community sample of adults. We hypothesized that heavy drinkers would exhibit greater ECF deficits than those consuming less alcohol. We also explored whether demographic factors such as gender, age, education, and recent illicit drug use might affect the ECF-drinking relation. For example, given evidence suggesting that women are more vulnerable to alcohol's neurotoxic effects (Hashimoto & Wiren, 2008; Mann et al., 2005), we examined whether women exhibit greater ECF impairment than men at the same average daily alcohol volume.

2. Material and methods

2.1. Participants

A community sample of couples, 280 men (M age = 36.9 years, SD = 5.8) and 280 women (M age = 35.4 years, SD = 5.9), was recruited via mailed survey (21,000 surveys mailed; 26% response rate; see Testa et al., 2012 for detail). The majority were White (91% each), fairly well-educated (58% of men and 67% of women completed college), and employed at least part-time (91% of men and 80% of women). Participants were demographically similar to the current population of couples in the county who are either married or living together as married (U.S. Census Bureau, 2011). Couples were excluded if either partner reported a current medical condition or past head injury that might influence ECF. Eligible couples attended a session that included ECF tasks, questionnaires assessing alcohol and drug use, relationship functioning, partner aggression, and a marital conflict interview. Because the larger study examined varying patterns of drinking in couples, we oversampled for couples in which one or both of the members were heavy drinkers (HD) resulting in recruitment of 159 HD men, 120 HD women, 121 control men and 160 control women. HD was defined as consuming 5 or more drinks at one time (4 drinks for women) or becoming intoxicated at least weekly. Given the oversampling approach, all analyses were conducted using sampling weights, in essence providing a more precise estimate of the effects of HD. All participants provided informed consent and the study protocol was approved by the affiliated Institutional Review Board.

2.2. Procedures

Participants completed the following measures:

Alcohol Use. Beverage-specific questions on frequency of consumption in the past year and quantity of alcohol consumed in a typical drinking event (Cahalan, Cisin, & Crossley, 1969) were used to compute a measure of average daily alcohol consumption (drinks/day).

Drug Use in the Past Year. Because illicit drug use has been shown to affect ECF (Fernández-Serrano, Pérez-García, Río-Valle, & Verdejo-García, 2010), participants were asked to rate drug use in the past year (Not at all, Once, A few times, About once a month, 1–2 times a month, or Once a week or more) for six non-prescription drug categories (sedatives, stimulants, hallucinogens, marijuana, cocaine, heroin/methadone). One-hundred twenty-three participants (48 women) reported using illicit drugs in the past year.

Dysexecutive Functioning Questionnaire (DEX; Wilson et al., 1996) Respondents rated how often they observe 20 executive problems on a Likert scale resulting in a total score. Higher scores reflect greater ECF impairment.

Stroop Color–Word Task (Stroop, 1935). Participants read words (Word) or named the ink color (Color, Color–Word) for as many stimuli as they could in 45 s. A Color–Word interference score was calculated according to Golden and Freshwater (2002). Lower scores indicate poorer attentional control.

WAIS-III Digit Span (The Psychological Corporation, 1999). A sequence of digits (one per second) was read to the participant. For the Backward condition (working memory), the participant was asked to repeat the sequence in the reverse order. The number of digits increased with successful trials. Number of successful trials was summed for total scores. The Backward score was subjected to a square root transformation.

Trail Making Test (Reitan, 1958). The TMT is a measure of cognitive flexibility, visual attention and motor speed (Lezak, Howieson, & Loring, 2004). In TMT-A, the participant must draw a line connecting a series of numbers in sequential order. TMT-B requires the participant to draw a line connecting a series of letters and numbers alternating between sequential and alphabetical order. Completion time scores were subjected to logarithmic transformations.

Wisconsin Card Sorting Test. The WCST (Heaton, Chelune, Talley, Kay, & Curtis, 1993) is a measure of cognitive flexibility and perseverative responding in which the participant is presented with one card printed with 1 of 4 symbols in one of four colors. The participant was asked to match each card to one of the four stimulus cards according to a principle that s/he must deduce from the pattern of the examiner's response to each placement. Scores derived include perseverative errors (inverse transformation), non-perseverative errors (logarithmic transformation), conceptual level of response (square root transformation), number of categories completed (inverse transformation), and failure to maintain set (inverse transformation).

GoStop Task (Dougherty, Mathias, Marsh, & Jagar, 2005). Number stimuli were displayed on a computer screen for 500 ms. Half of the stimuli were target trials (matching stimuli requiring a response) and half were filler trials (non-matching stimuli). Half of the target trials were "stop" trials in which participants were signaled to withhold a response 50 to 350 ms after the stimulus appears. The GoStop Ratio, calculated as the number of response inhibition failures (i.e., responses to *stop* trials) relative to the number of responses to *go* trials was the primary dependent variable. Ratios for 150 and 250 ms stop trials provide the best group discrimination (e.g., Marsh, Dougherty, Mathias, Moeller, & Hicks, 2002). Number of commission errors (responses to fillers) was also recorded as a measure of impulsive responding.

3. Results

3.1. Preliminary analyses

Due to the disproportionate sampling method, all analyses were conducted using sample weights. Men (M = 1.24, SD = 1.71) consumed significantly more alcohol than women (M = 0.47, SD = 0.87), $t(544)$ = 6.66, $p < .001$. Alcohol consumption was positively correlated with age, $r(546) = .10$, $p = .025$, and negatively correlated with education, $r(546) = -.16$, $p < .001$. Those who used non-prescription drugs (M = 2.08, SD = 2.10) consumed more alcohol than those who did not (M = 0.69, SD = 1.20), $t(544) = -7.84$, $p < .001$. Table 1 depicts descriptive statistics and intercorrelations of ECF measures. Variables from different tasks were very weakly correlated within couples ($rs < .14$), and were not strongly correlated with each other ($rs < .30$), thus we examined each ECF measure separately in the following analyses.

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