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## Hazardous drinking and dimensions of impulsivity, behavioral approach, and inhibition in adult men and women

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### Abstract

**Introduction**—Hazardous drinking is characterized by decisions to engage in excessive or risky patterns of alcohol consumption. Levels of impulsivity and behavioral approach and inhibition may differ in hazardous drinkers and nonhazardous drinkers. A comparison of the relative levels of dimensions of impulsivity and behavioral inhibition and approach in adult men and women hazardous and nonhazardous drinkers may inform treatment and prevention efforts.

**Methods**—In the present research, 466 men and women from a community sample were administered the Alcohol Use Disorders Identification Test (AUDIT), the Behavioral Inhibition System/Behavioral Approach System (BIS/BAS) Scale, and the Barratt Impulsiveness Scale, version 11 (BIS-11). Relations among the dimensions of these constructs were examined using Multivariate Analysis of Covariance (MANCOVA), with age and race as covariates.

**Results**—There were main effects of hazardous drinking on all three dimensions of impulsivity, the behavioral inhibition system, and the behavioral activation system Reward-Responsiveness, and Fun-Seeking components, with hazardous drinkers scoring higher than non-hazardous drinkers.

**Conclusion**—This research provides a better understanding of the manner in which impulsivity and behavioral inhibition and approach tendencies relate to hazardous alcohol use in men and women. The present results have implications for alcohol-related prevention and treatment strategies for adult men and women.

### Keywords

impulsivity; behavioral approach; behavioral inhibition; hazardous drinking; sex

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## Introduction

Hazardous alcohol use is associated with many public health problems (Room et al., 2005), and can be considered in the broader framework of risk-taking (Fergusson and Lynskey, 1996; Fernie et al., in press; Stein et al., 2005) and poor decision-making (Goudriaan et al., 2007; Hildebrandt et al., 2008). Impulsivity reflects a tendency for rapid action with diminished regard for future consequences (Moeller et al., 2001). The psychological construct behavioral approach is characterized by appetitive, goal-oriented functioning and positive affect, while behavioral inhibition is characterized by inhibition in response to aversive stimuli (Gray, 1972). Impulsivity (Lejuez et al., 2010; MacKillop et al., 2007) and behavioral approach (Franken and Muris, 2006; Hundt et al., 2008; O'Connor et al., 2009) are separate but related constructs that each are positively associated with alcohol consumption. The present research was conducted to compare dimensions of impulsivity and behavioral inhibition system and behavioral approach system sensitivity in hazardous and nonhazardous-drinking adult men and women, and to determine which of these psychological factors are associated the most strongly with hazardous drinking.

The association of impulsivity with alcohol consumption has been reported in both human and animal research (Lejuez et al., 2010; Poulos et al., 1995). In rodents, amount of alcohol consumption has been associated with level of impulsivity on a behavioral task (Poulos et al., 1995). In humans, impulsivity has been associated with multiple stages of alcohol use: initiation of alcohol use, current use, early indicators of alcohol problems and alcohol abuse (Lejuez et al., 2010). Impulsivity, as measured by the Barratt Impulsiveness Scale, version-11 (BIS-11), is comprised of three dimensions: attentional, non-planning, and motor impulsivity (Patton et al., 1995). Stanford and colleagues (2009) conducted an extensive review of research with the BIS-11 and noted the value of assessing impulsivity with the BIS-11 subscales, an approach that was used in the present research (Stanford et al., 2009).

The three dimensions of impulsivity may be differentially associated with hazardous drinking. Although there were no differences in previous research between men and women or binge drinkers and non-binge drinkers on the three dimensions of impulsivity in an undergraduate sample, differential associations emerged between dimensions of impulsivity and various indicators of hazardous alcohol use (Balodis et al., 2009). Specifically, motor impulsivity and attentional impulsivity correlated with number of drinks per drinking occasion, and attentional impulsivity correlated with the length of drinking occasions. In a community sample of adult men and women, all three dimensions of impulsivity (non-planning, attentional, and motor impulsivity), as well as overall impulsivity, were independently predictive of alcohol consumption (Fox et al., 2010). There may be differences in the extent to which hazardous drinking associates with the various dimensions of impulsivity in the present community sample of adult men and women.

Related to impulsivity (Meda et al., 2009), the behavioral approach system is a reward-sensitive neural system thought to mediate appetitive, goal-oriented functioning and positive affect, while the behavioral inhibition system subserves inhibition in response to aversive stimuli and is implicated in punishment sensitivity. Historically, high behavioral approach system activation was thought to underlie impulsivity (Fowles, 1987; Gray, 1982). However, recent research has revealed that behavioral approach system activation and impulsivity as measured by the BIS-11 are separate but related constructs (Meda et al., 2009; Quilty and Oakman, 2004). Impulsivity has been reported to partially mediate the relationship between behavioral inhibition system and behavioral approach system activation and health risk behaviors (Braddock et al., 2011).

Carver and White (1994) identified three behavioral approach system dimensions (Drive, Reward Responsiveness, and Fun-Seeking) in their study of the behavioral inhibition system and behavioral approach system. High behavioral approach system sensitivity, as indicated by higher scores on the behavioral approach system measures, was associated with alcohol misuse and abuse (Hundt et al., 2008). The Fun-Seeking dimension of the behavioral approach system was associated with alcohol use (Loxton and Dawe, 2001; O'Connor et al., 2009; Voigt et al., 2009), risky alcohol consumption (Franken and Muris, 2006; O'Connor et al., 2009), and longtime alcohol abuse (Johnson et al., 2008). The Drive dimension was strongly associated with alcohol use in a sample of teenage girls (Loxton and Dawe, 2001). In heavy drinkers, higher Reward Responsiveness was associated with increased reactivity to an alcohol cue (Kambouropoulos and Staiger, 2001). Previous research has shown that behavioral inhibition system activation tends either to be negatively correlated with alcohol use (Franken and Muris, 2006; Loxton and Dawe, 2001) or not to be associated with alcohol use (O'Connor et al., 2009; Voigt et al., 2009), suggesting that if behavioral inhibition system sensitivity, as indicated by higher scores on the behavioral inhibition system measure, is implicated in alcohol use, it may serve a protective role against hazardous drinking. While the influence of behavioral inhibition system and behavioral approach system dimensions on hazardous alcohol use has been described, the relative associations of behavioral inhibition system and behavioral approach system dimensions and impulsivity dimensions with hazardous drinking have not been previously compared.

Gender differences have been noted in addictive processes, including drinking behavior (Holmila and Raitasalo, 2005; Livingston and Room, 2009; Wilsnack et al., 2000). While similar levels of impulsivity in men and women have been reported (Patton et al., 1995), research investigating the association between impulsivity and drinking behavior has been mixed with respect to sex differences. Similar relationships of impulsivity and drinking behavior have been reported in undergraduate men and women (Balodis et al., 2009), although other data indicate that sex moderates the association between impulsivity and alcohol use in an undergraduate sample, with a stronger association between impulsivity and alcohol use occurring in men than women (Stoltenberg et al., 2008). Research also is mixed with respect to sex differences in behavioral inhibition system and behavioral approach system sensitivity. There were sex differences in one of four experiments included in a research paper (Carver and White, 1994), with men having lower levels of behavioral inhibition system activation and Reward Responsiveness than women. A direct comparison of the levels of different dimensions of impulsivity and behavioral inhibition and approach in hazardous- and non-hazardous-drinking men and women would aid prevention and treatment development efforts.

In the present research, levels of impulsivity dimensions and theoretically related, yet distinct, behavioral inhibition system and behavioral approach system dimensions were compared in hazardous-drinking and non-hazardous-drinking adult men and women to more fully characterize the relationship between hazardous drinking and psychological factors. In addition, levels of the dimensions of impulsivity and behavioral approach and inhibition were directly compared in hazardous and non-hazardous-drinking adult men and women to determine which psychological constructs differ the most between hazardous and non-hazardous drinkers. It was hypothesized in the present research that attentional impulsivity, motor impulsivity, and non-planning impulsivity, as well as behavioral activation systems measures of Drive, Fun-Seeking, and Reward Responsiveness, would be higher in adult hazardous drinkers than in adult non-hazardous drinkers, and that behavioral inhibition system sensitivity would be lower in adult hazardous drinkers than in adult non-hazardous drinkers. Lastly, because human and animal research has demonstrated that impulsivity is strongly linked to alcohol consumption (Belin, 2008; Dalley et al., 2011; Lejuez et al., 2010; Poulos et al., 1995), it was hypothesized that differences between adult hazardous and non-

hazardous-drinkers would be stronger with respect to impulsivity dimensions than behavioral inhibition system and behavioral approach system dimensions.

## Methods

### Participants

446 participants (240 female, 206 male) were recruited from the New Haven, CT area by advertisements in local newspapers or online. A community sample was recruited to assess history of psychiatric, psychosocial and addictive behaviors and measures of impulsivity and self-control. This included psychiatric data using the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID) (First et al., 1997) and assessment of quantity/frequency of licit drug use. Eligibility for the study was determined in an initial phone screen. In order to be eligible for the study, participants were required to be aged between 18 and 50 years and able to read and write in English to at least a sixth-grade level. With the exception of nicotine and alcohol use disorders, study exclusion criteria included meeting current diagnostic criteria for a DSM-IV-TR (American Psychiatric Association, 2000) psychiatric disorder or substance dependence as determined by the SCID. However, any participant requiring alcohol detoxification was excluded from the study. Individuals currently using prescription opiates, methadone, and medications for other acute or chronic psychiatric or medical conditions also were excluded. All participants gave written informed consent, and the study was approved by the Human Investigation Committee of the Yale University School of Medicine.

### Procedure

After the initial phone screening to determine eligibility, participants were scheduled for assessment and evaluation at the Yale Stress Center. Participants completed basic demographic questionnaires and assessments of alcohol use (Alcohol Use Disorders Test - AUDIT), behavioral inhibition and approach (BIS/BAS), and impulsivity (BIS-11). Participants were administered breath alcohol testing and urine toxicology screens to verify self-reported alcohol and drug use information.

### Assessments

**Alcohol Use Disorders Test (AUDIT; Babor et al., 2001)**—Hazardous drinking was assessed using the Alcohol Use Disorders Test (AUDIT). The AUDIT is a 10-item screening instrument that identifies drinking behaviors and distinguishes between low-risk drinkers and individuals with hazardous or risky patterns of alcohol use. In the AUDIT screen, individuals endorse one of five responses (i.e., 0 = Never, 1 = Less than Monthly, 2 = Monthly, 3 = Weekly, 4 = Daily or Almost Daily) to items such as, “How often during the last year have you been unable to remember what happened the night before because you had been drinking?” The AUDIT accurately assesses severity of problematic alcohol use behaviors across age, sex, and cultures (Allen et al., 1997). Women with an AUDIT score of 4 or greater and men with an AUDIT score of 8 or greater were categorized as hazardous drinkers in the present research (Babor et al., 2001; Bradley et al., 1998; Reinhert and Allen, 2002; von der Pahlen et al., 2008). AUDIT score was dichotomized into hazardous drinking and non-hazardous drinking in order to determine psychological factors associated with hazardous drinking using Multivariate Analyses of Covariance (MANCOVA). AUDIT scores have been correlated with those on the Michigan Alcohol Screening Test (MAST) (Bohn et al., 1995) and the CAGE alcohol screening instrument (Hays et al., 1995) as well as with future indicators of alcohol-related problems (Claussen and Aasland, 1993). The AUDIT has high test-retest reliability (Daepfen et al., 2000) and internal consistency reliability (Ivis et al., 2000).

**Barratt Impulsiveness Scale (BIS-11; Patton et al., 1995)**—The BIS-11 is a 30-item self-report questionnaire that assesses impulsivity and shows good test-retest reliability (Patton et al., 1995). In the BIS-11, participants endorse a response on the four-point Likert-like scales (1 = Rarely/Never, 2 = Occasionally, 3 = Often, 4 = Almost Always/Always) in response to each of 30 items (e.g., “I say things without thinking”). The three dimensions of impulsivity are assessed by subscales: attentional impulsivity, motor impulsivity, and non-planning impulsivity. The attentional impulsivity subscale measures tendencies related to attention and decision-making, the motor impulsivity subscale measures tendencies to act without fully thinking through consequences of the action, and the non-planning impulsivity subscale measures tendencies not to plan ahead. The three BIS-11 dimensions are non-overlapping and demonstrate good reliability (Spinella, 2007). The BIS-11 is widely used in research and clinical settings, and elevated scores are typically observed in individuals with disorders with deficits in impulse control as a component, including substance abuse (Lejuez et al., 2007).

**Behavioral Inhibition System/Behavioral Approach System (BIS/BAS) Scale (Carver and White, 1994)**—The BIS/BAS scale measures behavioral inhibition and behavioral approach (Gray, 1972; Gray, 1981). The measure consists of 24 statements regarding behavioral style (e.g., “When I get something I want, I feel excited and energized”) with which the participant may indicate agreement or disagreement using a Likert-style scale (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree). The BIS/BAS scale is both reliable and valid (Carver and White, 1994; Jorm et al., 1998). The four dimensions of the BIS/BAS scale are behavioral inhibition system, Reward Responsiveness, Drive, and Fun-Seeking. The behavioral inhibition system subscale measures inhibition in response to aversive stimuli, while the behavioral activation system-related subscales assess aspects of behavioral approach. Specifically, the Reward-Responsiveness subscale measures positive responses to anticipated or granted rewards, the Drive subscale measures the pursuit of goals, and the Fun-Seeking subscale measures the spontaneous approach of potential rewards and a desire for new rewards (Carver and White, 1994).

### Data Analytic Strategy

All analyses were conducted using SPSS (version 16.0, SPSS Inc.), and the MANCOVA analysis was conducted using a Bonferroni correction. First, chi-square analyses were conducted to investigate differences between male and female participants on sociodemographic variables. Then, to address hypotheses about levels of impulsivity and behavioral approach and inhibition dimensions in hazardous and non-hazardous-drinking men and women, the variables were examined using a MANCOVA, with age and race as covariates. Race was used as a covariate because the number of African American women in our sample differed significantly from the number of African American men, and the number of men and women also differed significantly among people categorized as “Other.” Age was used as a covariate because associations of impulsivity and alcohol use tend to change with age (Littlefield et al., 2010). These analyses were conducted to determine which psychological factors were associated with hazardous alcohol use. While hazardous drinking was categorized by cut-off scores that were thresholded differently for men and women (Babor et al., 2001; Bradley et al., 1998; von der Pahlen et al., 2008), a common AUDIT cut-off score of 8 also has been used to identify hazardous drinking in previous research (Allen et al., 1997; Conigrave et al., 1995; Steinbauer et al., 1998). In addition to using AUDIT score cut-offs that were tailored to men and women, a MANCOVA also was conducted using a common cut-off score of 8 for men and women to determine whether any effects observed resulted from differential score treatment.



## Results

### Demographics

Demographic, psychological and alcohol-related variables are reported (Table 1). There were sex differences in race/ethnicity, with more women than men who were African American and classified as “Other,” a category which included individuals of Hispanic, Asian, and multi-racial origins.

### Factors associated with hazardous drinking and sex

There were main effects of hazardous drinking on attentional [ $F(1,440) = 27.10, p < 0.001, \eta^2 = 0.06$ ], motor [ $F(1,440) = 32.91, p < 0.001, \eta^2 = 0.07$ ], and non-planning [ $F(1,440) = 17.62, p < 0.001, \eta^2 = 0.04$ ] impulsivity, with hazardous-drinkers having higher scores than nonhazardous-drinkers on each of the dimensions of impulsivity (Figure 1, Table 2). There also were main effects of hazardous drinking on activation of behavioral inhibition [ $F(1,440) = 11.99, p < 0.001, \eta^2 = 0.03$ ], Reward Responsiveness [ $F(1,440) = 7.28, p < 0.01, \eta^2 = 0.02$ ], and Fun-Seeking [ $F(1,440) = 28.90, p < 0.001, \eta^2 = 0.07$ ], with hazardous drinkers having higher scores than non-hazardous drinkers on the behavioral inhibition system, Reward Responsiveness, and Fun-Seeking subscales. Hazardous drinkers did not differ significantly from non-hazardous drinkers on Drive activation [ $F(1,440) = 4.31, p = 0.04, \eta^2 = 0.01$ ] after the Bonferroni correction. Results are collapsed across sex in Figure 1 because there was no main effect of sex on dimensions of impulsivity.

There were main effects of sex on behavioral inhibition [ $F(1,440) = 41.34, p < 0.001, \eta^2 = 0.09$ ] and Reward Responsiveness [ $F(1,440) = 13.64, p < 0.001, \eta^2 = 0.03$ ], with women having higher behavioral inhibition system and Reward Responsiveness scores than men (Figure 2, Table 2). There were no effects of sex on attentional impulsivity [ $F(1,440) = 0.00, p = 0.97, \eta^2 = 0.00$ ], motor impulsivity [ $F(1,440) = 2.76, p = 0.10, \eta^2 = 0.01$ ], non-planning impulsivity [ $F(1,440) = 0.47, p = 0.50, \eta^2 = 0.00$ ], BAS Drive [ $F(1,440) = 0.82, p = 0.37, \eta^2 = 0.00$ ], and Fun-Seeking [ $F(1,440) = 1.07, p = 0.30, \eta^2 = 0.00$ ]. Results are presented by sex in Figure 2 because there were main effects of sex on behavioral inhibition and Reward Responsiveness.

There were no interactions of hazardous drinking and sex on attentional impulsivity [ $F(1,440) = 0.03, p = 0.87, \eta^2 = 0.00$ ], motor impulsivity [ $F(1,440) = 1.29, p = 0.26, \eta^2 = 0.00$ ], non-planning impulsivity [ $F(1,440) = 0.29, p = 0.59, \eta^2 = 0.00$ ], behavioral inhibition system [ $F(1,440) = 0.47, p = 0.50, \eta^2 = 0.00$ ], Drive [ $F(1,440) = 0.20, p = 0.66, \eta^2 = 0.00$ ], Fun-Seeking [ $F(1,440) = 0.05, p = 0.83, \eta^2 = 0.00$ ], and Reward Responsiveness [ $F(1,440) = 0.13, p = 0.72, \eta^2 = 0.00$ ].

A MANCOVA with age and race as covariates also was conducted using a common AUDIT cut-off score of 8 to identify hazardous drinking in both men and women. When using a cut-off score of 8, the effects were the same as when the cut-off score that was tailored to sex was used, except that the main effect of hazardous drinking on Reward Responsiveness activation was no longer significant [ $F(1,440) = 3.045, p = 0.08, \eta^2 = 0.01$ ].

## Discussion

Levels of impulsivity and behavioral approach and inhibition were investigated in a community sample of adult social drinkers that included both hazardous and non-hazardous drinkers. There were several hypotheses. First, it was hypothesized that the three dimensions of impulsivity would be higher in hazardous drinkers than in non-hazardous drinkers. Second, it was hypothesized that in hazardous drinkers versus non-hazardous drinkers, behavioral inhibition would be lower and the three behavioral approach dimensions would

be higher. Lastly, it was hypothesized that differences between hazardous and non-hazardous-drinkers would be stronger with respect to impulsivity dimensions than behavioral inhibition system and behavioral approach system dimensions. Overall, the present research had several principle findings. Hazardous drinkers had higher levels of all three dimensions of impulsivity (attentional, non-planning, and motor impulsivity), behavioral inhibition, and two of the behavioral approach dimensions (Reward Responsiveness and Fun-Seeking) than did non-hazardous drinkers. Additionally, hazardous drinking was more strongly associated with dimensions of impulsivity than dimensions of behavioral approach and inhibition. Each of the major findings and its implications is discussed below.

### **Hazardous drinking and dimensions of impulsivity, behavioral inhibition, and behavioral approach**

The higher levels of attentional, non-planning, and motor impulsivity in hazardous drinkers than in nonhazardous-drinkers found in the present research support our *a priori* hypothesis and are consistent with previous research (Balodis et al., 2009; Fox et al., 2010). Higher levels of Reward Responsiveness and Fun-Seeking in hazardous drinkers than in non-hazardous drinkers also support our *a priori* hypothesis and are consistent with previous research (Loxton and Dawe, 2001; O'Connor et al., 2009; Voigt et al., 2009). However, the positive relationship between hazardous drinking and behavioral inhibition system sensitivity reported in the present research is inconsistent with the hypothesized effect and with previous reports (Franken and Muris, 2006; Loxton and Dawe, 2001). The divergence may be accounted for by differences in sample characteristics. The present research was based on results from an adult community sample with a mean age of 30 years that was evenly divided between men and women. Research reporting no association of behavioral inhibition system sensitivity with alcohol use was based on results from younger, undergraduate samples (O'Connor et al., 2009; Voigt et al., 2009), while research reporting a negative association of behavioral inhibition system sensitivity with alcohol use was based on a predominantly female sample of undergraduates (Franken and Muris, 2006) and an entirely female sample of adolescents (Loxton and Dawe, 2001). Therefore, the fact that our study used an older sample from the community could suggest that associations between behavioral inhibition system activation and alcohol use may depend on age, sex, and education-related characteristics, and that a positive association between behavioral inhibition system activation and alcohol use may emerge during adulthood. The positive relationship of behavioral inhibition system activation and hazardous-drinking reported in the present research may result from increased drinking to relieve anxiety associated with heightened punishment sensitivity (Khantzian et al., 1974), or alternatively, it could result from increased anxiety resulting from hazardous drinking. In addition, the absence of an effect of hazardous drinking on Drive activation was inconsistent with the hypothesis and with previous research (Loxton and Dawe, 2001), and also may result from age and sex differences.

### **Sex differences**

The finding that women had higher scores than men on behavioral inhibition and Reward Responsiveness replicates the research of Carver and White (1994) in which sex differences in the same direction were reported on those dimensions. Greater behavioral approach and inhibition in women than men has implications for multiple behaviors that are influenced by behavioral inhibition system and behavioral approach system sensitivity, including problematic alcohol use (Hundt et al., 2008; Loxton and Dawe, 2001; Voigt et al., 2009). For example, with respect to risky alcohol use, women's greater emotional responsiveness to rewarding and aversive stimuli may contribute to hazardous drinking in women.

When using the common AUDIT cut-off score of 8, the effect of hazardous drinking on BAS Reward Responsiveness became a non-significant trend, suggesting that this factor continued to contribute to hazardous drinking when the common cut-off score was used, although the contribution was somewhat diminished. All other reported effects remained the same when using the common AUDIT cut-off score. When using the tailored AUDIT hazardous-drinking cut-off scores of 4 for women and 8 for men, there were no sex differences in hazardous drinking, which is consistent with reports of similar levels of problematic alcohol use in men and women in recent years that may be attributable to increased drinking in women (Keyes et al., 2008). However, there also have been reports of more hazardous drinking in men than women (Holmila and Raitasalo, 2005; Livingston and Room, 2009; Wilsnack et al., 2000). When the common AUDIT hazardous-drinking cutoff score of 8 for both men and women was used in the present research, there was a sex difference in hazardous drinking, with more men than women engaging in hazardous drinking. Less behavioral inhibition system and BAS Reward Responsiveness in men than women may increase their risk for hazardous alcohol drinking. It is possible that more men are hazardous drinkers than women because they are less sensitive to the aversive aspects of hazardous drinking (i.e., after-effects, social consequences), and they must drink more than women to experience the same amount of reward because they are less sensitive to the rewarding aspects of alcohol consumption. Greater behavioral inhibition system and Reward Responsiveness in women than men may have implications for tailoring treatment and prevention strategies to men and women. Hazardous drinking treatment and prevention strategies for both men and women should focus on impulsivity as well as behavioral inhibition and approach. However, strategies for men may target reduced emotional responsiveness to both pleasant and aversive stimuli and teach alternative coping strategies.

### **Relative contributions of impulsivity and behavioral inhibition system and behavioral approach system sensitivity to hazardous-drinking**

In hazardous drinkers there were elevated scores on most of the dimensions of impulsivity and behavioral approach and inhibition. This is consistent with previous research in which problem drinking was associated with impulsivity (Carlson et al., 2010; Fox et al., 2010) and behavioral approach and inhibition (Hundt et al., 2008; Voigt et al., 2009). However, the present research was the first to consider the joint contribution of impulsivity and behavioral inhibition system and behavioral approach system sensitivity to hazardous drinking in an adult community sample of men and women. When considering the variables together, impulsivity made the largest contribution to problematic alcohol use behavior, supporting our hypothesis. Traditionally, an effect size of  $\eta^2 = 0.01$  is considered small, an effect size of  $\eta^2 = 0.06$  is considered medium, and an effect size above  $\eta^2 = 1.4$  is considered large (Cohen, 1973). Following these guidelines, the effect sizes for the main effect of hazardous drinking on the dimensions of impulsivity were medium (Cohen, 1973), while the effect sizes for the main effect of hazardous drinking on behavioral inhibition system and behavioral approach system dimensions were small (with the exception of the Fun-Seeking effect size, which was medium). Therefore, it appears that impulsivity dimensions differ more in hazardous and non-hazardous drinkers than do behavioral inhibition system and behavioral approach system dimensions.

### **Implications for treatment and prevention of hazardous-drinking**

In addition to revealing higher impulsivity and behavioral approach system dimensions in hazardous drinkers than non-hazardous drinkers, the present research was the first to reveal higher behavioral inhibition system sensitivity in hazardous drinkers than in non-hazardous drinkers. Individuals with high levels of behavioral inhibition may engage in hazardous drinking in response to stress associated with their increased punishment sensitivity (Khantzian et al., 1974; Sinha, 2008). Because impulsivity, behavioral inhibition, and



behavioral approach dimensions each were elevated in hazardous drinkers, elevated levels of these psychological factors may be potential risk factors for alcohol problems. Treatment and prevention efforts that are tailored to individuals who have been identified to have high levels of impulsivity, behavioral inhibition, and behavioral approach may be particularly beneficial. For example, additional prevention efforts that teach alternative strategies to manage stress associated with elevated punishment sensitivity may help to reduce hazardous drinking in individuals with high behavioral inhibition system levels. Programs designed to enhance impulse control may help to reduce hazardous drinking in impulsive individuals. In fact, the greater effect of impulsivity dimensions than behavioral inhibition system and behavioral approach system dimensions to be higher in hazardous drinkers suggests that prevention efforts focused to enhance impulse control may be the most beneficial for reducing hazardous drinking.

### **Limitations, summary, and conclusions**

The finding that impulsivity and behavioral approach were elevated in hazardous-drinking men and women is consistent with previous research in which alcohol use was associated with impulsivity (Dawe and Loxton, 2004; Fox et al., 2010; Gullo et al., 2010; Lejuez et al., 2010; MacKillop et al., 2007), behavioral approach system sensitivity (Franken and Muris, 2006; Hundt et al., 2008; Johnson et al., 2008; Loxton and Dawe, 2001; Voigt et al., 2009), and the combination of impulsivity, as assessed by the Impulsive Sensation Seeking scale (Zuckerman et al., 1993) and behavioral approach system sensitivity (Braddock et al., 2011). The present research reinforces the importance of these psychological constructs in hazardous drinking. In addition, the present research extends the literature by comparing impulsivity dimensions (as assessed by the BIS-11) and behavioral inhibition system and behavioral approach system dimensions in hazardous and non-hazardous drinkers to determine which factors have a greater contribution to hazardous drinking.

In the present research, the association of psychological factors, such as impulsivity, on hazardous alcohol use was examined. Strengths of the study include the use of well-validated measures and the assessment of a large community sample of adult men and women. While the present research reveals how dimensions of impulsivity and behavioral approach and inhibition differ in hazardous and non-hazardous drinking men and women, one limitation of the study is that the cross-sectional design does not allow causal relationships to be determined. A longitudinal study may have provided the opportunity to assess whether impulsivity dimensions and increased behavioral approach and inhibition predated hazardous alcohol drinking. Reliance on self-report measures is a second limitation of the present research. Because behavioral measures of impulsivity are not always correlated with self-report measures of impulsivity (Reynolds et al., 2006), future studies should examine behavioral measures of impulsivity to determine whether the relationship between impulsivity and hazardous drinking generalizes to various types of impulsivity. Behavioral and self-report measures of impulsivity may relate differently to important clinical factors like treatment outcome (Krishnan-Sarin et al., 2007). In addition, it is important to note that the present study is limited by the use of a single measure of alcohol use, the AUDIT. However, two additional alcohol-related outcomes, drinks per day and drinking days per week, were included in Table 1 to more fully-characterize the alcohol consumption of the participants. Additional measures of alcohol use (i.e. consumption of alcohol in the laboratory) would have strengthened the study. The validity of self-report measures depends on participants' ability to accurately characterize their own behavioral styles and patterns of alcohol consumption, as well as their willingness to provide this information. Future research should determine whether there are differences in the extent to which psychological factors, such as impulsivity and behavioral approach and inhibition, associate with other maladaptive behaviors.

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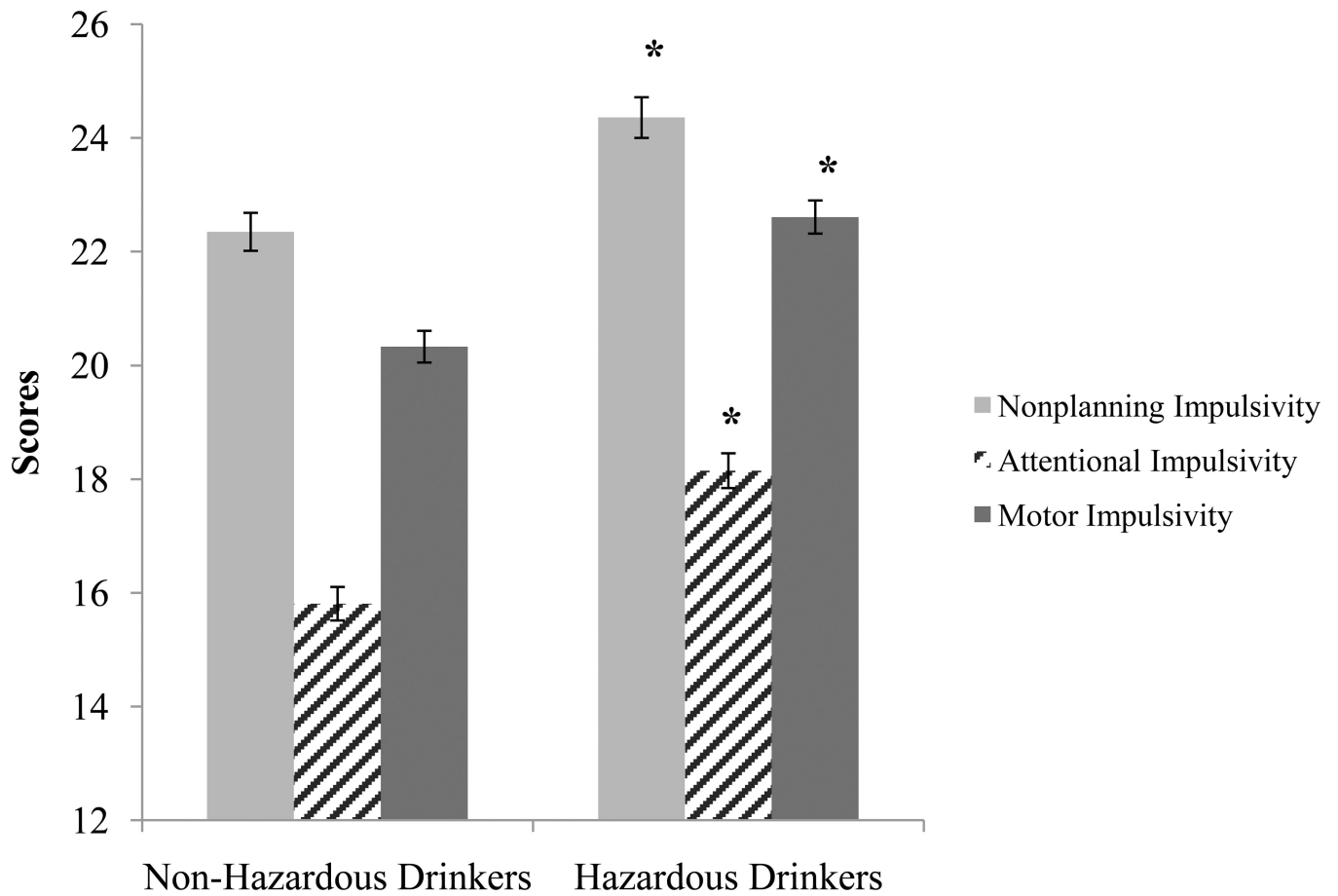
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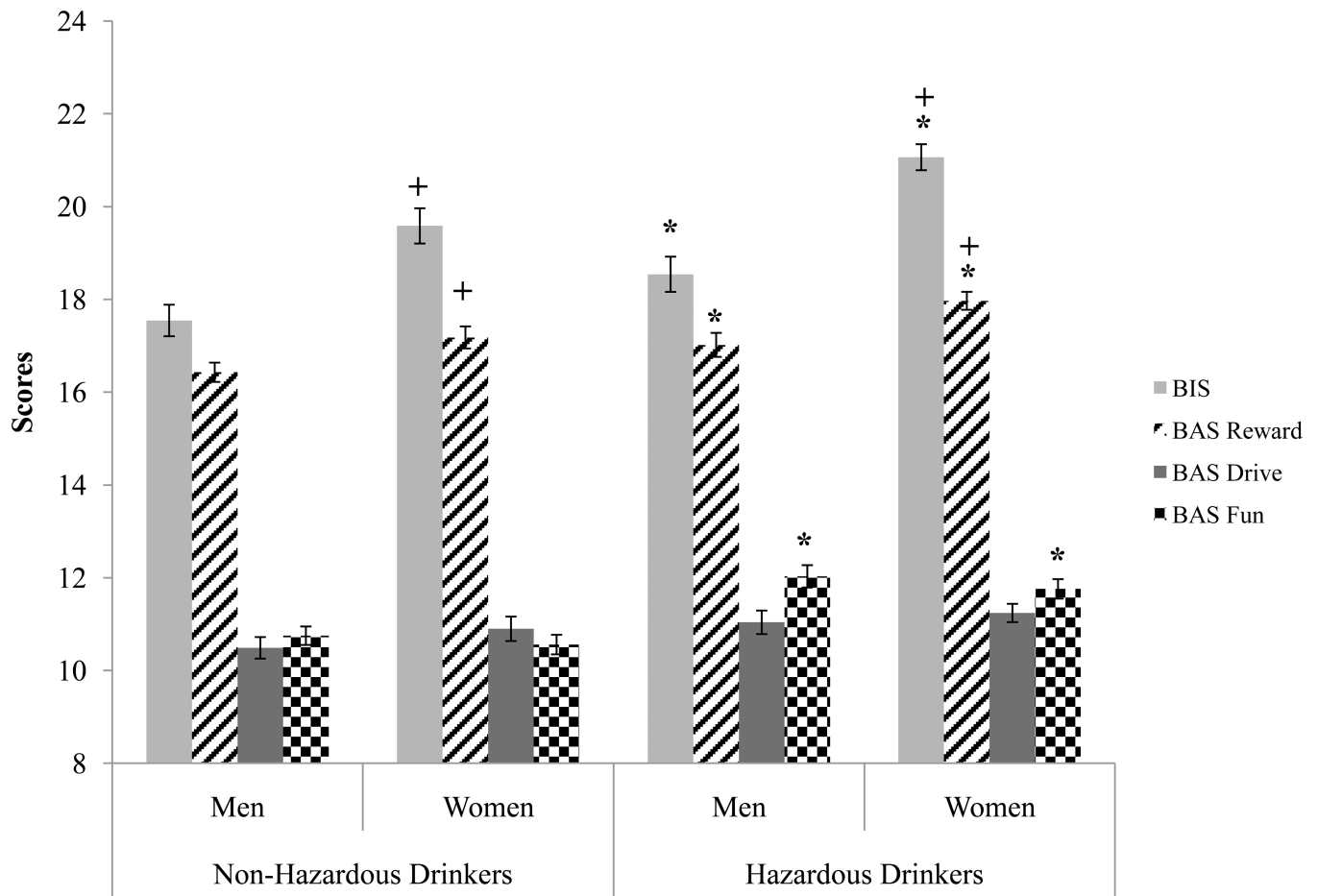
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**Figure 1.**

BIS-11 attentional impulsivity, non-planning impulsivity, and motor impulsivity scores [Mean  $\pm$  Standard Error of the Mean (S.E.M.)] are represented for participants in the hazardous- and non-hazardous-drinking categories. The \* symbol denotes a statistically significant difference between hazardous drinkers, in which hazardous drinkers had higher mean scores compared to non-hazardous drinkers.



**Figure 2.** Behavioral inhibition system and BAS Drive, BAS Fun-Seeking, and BAS Reward-Responsiveness scores (Mean  $\pm$  S.E.M.) are represented for men and women in the hazardous and non-hazardous drinking categories. The \* symbol denotes a statistically significant difference between hazardous drinkers, in which hazardous-drinkers had higher means than non-hazardous drinkers across sexes. The + symbol denotes a statistically significant sex difference between men and women, in which women had higher scores than men across drinking groups.

**Table 1**

## Demographics, Psychological Factors, and Alcohol-Related Characteristics

	Women (N = 240)	Men (N = 206)
Age (mean yrs. (S.D.))	30.0 (9.42)	29.96 (8.96)
Education (mean yrs. (S.D.))	14.86 (2.28)	14.91 (2.22)
Gender (n (%))	240 (53.81%)	206 (46.19%)
Race/ethnicity (n (%))		
African American <sup>a</sup>	62 (25.83%)	38 (18.45%)
Caucasian	144 (60.0%)	150 (72.82%)
Other <sup>a</sup>	34 (14.2%)	18 (8.73%)
Psychological Factors (mean (S.D.))		
BIS-11 total	61.39 (12.15)	62.06 (11.35)
Nonplanning	23.25 (5.42)	23.43 (5.06)
Attentional	17.04 (4.879)	16.86 (4.33)
Motor	21.17 (4.54)	21.76 (4.24)
BIS <sup>b</sup>	20.34 (3.74)	18.01 (3.67)
BAS	38.82 (5.70)	38.80 (5.70)
Reward Responsiveness <sup>b</sup>	17.58 (2.39)	16.70 (2.36)
Drive	11.07 (2.54)	10.75 (2.47)
Fun Seeking	11.17 (2.38)	11.35 (2.31)
Alcohol-Related Characteristics (mean (S.D.))		
AUDIT score <sup>b</sup>	5.67 (6.72)	8.64 (7.55)
Drinking days in past month <sup>b</sup>	5.63 (6.68)	9.04 (8.10)
Consumption in past month <sup>c2</sup>	23.53 (61.54)	56.30 (121.72)
Drinking Category (n (%)) <sup>1</sup>		
Hazardous	56 (23.3%)	95 (46.1%)
Non-Hazardous	184 (76.7%)	111 (53.9%)
Alcohol dependence (n (%))	14 (5.8%)	17 (8.3%)

<sup>a</sup>sex difference at  $p < 0.050$  in a Chi Square Test

<sup>b</sup>sex difference at  $p < 0.001$  in a t-test

<sup>c</sup>sex difference at  $p < 0.010$  in a t-test

<sup>1</sup>AUDIT hazardous cutoff score = 8

<sup>2</sup>number of alcoholic beverages

BIS = Behavioral Inhibition System, BAS = Behavioral Approach System, AUDIT = Alcohol Use Disorders Identification Test

Table 2

## MANCOVA

<b>Main effect of hazardous drinking:</b>			
	<b>F statistic</b>	<b>p value</b>	<b>partial <math>\eta^2</math></b>
Attentional Impulsivity	27.10	< 0.001	0.06
Motor Impulsivity	32.91	< 0.001	0.07
Nonplanning Impulsivity	17.62	< 0.001	0.04
BIS	11.99	< 0.001	0.03
Drive	4.31	0.04	0.01
Fun-Seeking	28.90	< 0.001	0.07
Reward Responsiveness	7.28	< 0.01	0.02
<b>Main effect of sex:</b>			
	<b>F statistic</b>	<b>p value</b>	<b>partial <math>\eta^2</math></b>
Attentional Impulsivity	0.00	0.97	0.00
Motor Impulsivity	2.76	0.10	0.01
Nonplanning Impulsivity	0.47	0.50	0.00
BIS	41.34	< 0.001	0.09
BAS Drive	0.82	0.37	0.00
Fun-Seeking	1.07	0.30	0.00
Reward Responsiveness	13.64	< 0.001	0.03
<b>Hazardous drinking <math>\times</math> sex interaction:</b>			
	<b>F statistic</b>	<b>p value</b>	<b>partial <math>\eta^2</math></b>
Attentional Impulsivity	0.03	0.87	0.00
Motor Impulsivity	1.29	0.26	0.00
Nonplanning Impulsivity	0.29	0.59	0.00
BIS	0.47	0.50	0.00
Drive	0.20	0.66	0.00
Fun-Seeking	0.05	0.83	0.00
Reward Responsiveness	0.13	0.72	0.00