



## Impulsivity moderates the association between physical activity and alcohol consumption

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### ABSTRACT

Mounting evidence indicates that physical activity and alcohol consumption are positively associated, but potential moderators of this relationship remain unclear. Both physical activity and alcohol drinking are potentially reinforcing and may be more strongly associated among individuals who tend to be higher in reward seeking and related processes governed by the prefrontal cortex. Thus, behaviors linked to the prefrontal cortex, such as impulsivity, may influence the association between physical activity and alcohol intake. The present study therefore evaluated dimensions of impulsivity as moderators of the association between physical activity and alcohol consumption. We surveyed 198 undergraduate students and obtained self-reports of their drinking habits, physical activity, and dimensions of impulsivity. We found that moderate but not vigorous physical activity was positively associated with drinking. Linear regression analyses were used to evaluate dimensions of impulsivity as moderators of the association between physical activity (vigorous or moderate) and drinks per week. Results revealed a consistent pattern of interactions between the positive urgency and sensation seeking dimensions of impulsivity and moderate physical activity on number of drinks per week. For both interactions, there was a significant positive association between moderate physical activity and drinking at higher but not lower levels of impulsivity. We conclude that impulsivity moderates the positive association between physical activity and alcohol consumption. These results have significant implications for the development of prevention and treatment programs for alcohol use disorders.

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### Introduction

Like all rewarding behaviors, exercise and alcohol consumption share common underlying brain circuitry (Nestler, 2005; Olsen, 2011; Perrotti et al., 2008; Volkow & Wise, 2005; Werme et al., 2002). This suggests that exercise experience may influence the effects of alcohol. In support of this idea, it has been shown that voluntary exercise reduces behavioral intoxication in a rodent model (Leasure & Nixon, 2010). Overlapping neural circuitry also suggests that exercise experience may influence alcohol intake behaviors. In support of this idea, several large studies of non-institutionalized adults in the United States indicate a significant positive association between physical activity and alcohol consumption (French, Popovici, & Maclean, 2009; Lisha, Martens, & Leventhal, 2011).

In humans, the relationship between physical activity and drinking has been studied in adolescent and undergraduate athletes. Many of these studies indicate heavier drinking in athletes compared to non-athlete peers (Dunn & Wang, 2003; Kokotailo, Henry, Kosciak,

Fleming, & Landry, 1996; Leichter, Meilman, Presley, & Cashin, 1998; Nattiv & Puffer, 1991; Wechsler, Dowdall, Davenport, & Rimm, 1995), although some do not (Elder, Leaver-Dunn, Wang, Nagy, & Green, 2000; Overman & Terry, 1991). Mixed findings suggest that the relationship between physical activity and alcohol consumption may differ as a function of physiological, neural, cultural, and/or personality factors. However, other than gender and age, factors that moderate the relationship between physical activity and alcohol intake have been understudied (Lisha et al., 2011).

To pinpoint factors that may influence this relationship, it is helpful to consider neurocircuitry. With any rewarding and potentially addictive behavior (including alcohol consumption), the transition from experimentation to increased use appears to be governed by the prefrontal cortex (Bechara, 2005; Koob & Le Moal, 2005). Moreover, the processes which govern reward seeking and impulsivity are likely to affect behaviors which are potentially reinforcing. Sensation seeking, which is one component of impulsivity, has been suggested as a potential factor in the association between physical activity and alcohol consumption, in that a “sensation-seeking lifestyle” may be consistent with engaging in both behaviors (French et al., 2009). More generally, impulsivity is a set of behavioral tendencies (Cyders & Smith, 2007) that confer

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vulnerability to the development of drug addiction (de Wit, 2009), and rely heavily on prefrontal cortical function (Fineberg et al., 2010; Perry et al., 2011). The present study evaluated dimensions of impulsivity as moderators of the association between physical activity and alcohol consumption in a sample of college students.

Research on impulsivity has long been hindered by a lack of uniformity in the definition of the construct. Cyders and Smith (2007) have developed a new measure of impulsivity, the UPPS-P, based on compelling evidence that impulsivity, or “rash action” has three distinct components. The first is mood-based and is composed of positive urgency (action driven by positive emotion) and negative urgency (action driven by negative emotion). The second component involves lack of conscientiousness, and includes lack of planning and lack of perseverance. The last component is sensation seeking. In the present study, we have utilized this conceptualization of the construct of impulsivity.

The objective of the present study was to determine whether impulsivity influences the relationship between physical activity and alcohol intake. Stated another way, we were interested in determining the extent to which impulsivity is characteristic of individuals who both drink and exercise. Accordingly, participants completed self-report measures of alcohol consumption, physical activity, and impulsivity. We hypothesized that the relationship between physical activity and alcohol intake would be strongest in individuals that score highly on the subscales of the UPPS-P, including sensation-seeking, negative and positive urgency, lack of premeditation, and lack of perseverance.

## Materials and methods

### Participants

Participants included 198 (173 women and 25 men) undergraduate psychology students at a large Southwestern university. The average age of participants was 24.11 years ( $SD = 6.92$ ). The race distribution was 39.27% Caucasian, 19.37% Asian/Asian American, 16.23% Black/African American, 1.57% Native Alaskan/Pacific Islander, 6.81% multi-racial, and 16.75% other. The ethnicity distribution was 30.61% Hispanic and 69.39% non-Hispanic. With the exception of gender, this sample was demographically similar to the university's undergraduate population. Written informed consent was obtained from all subjects, and all experimental procedures followed were in accordance with the ethical standards of the University of Houston's Committee for the Protection of Human Subjects and with the Helsinki Declaration of 1975, as revised in 1983.

### Procedure

After providing informed consent, participants completed a web-based survey which included measures of impulsivity, physical activity, and drinking. Participants received extra course credit in exchange for participation.

### Measures

#### Impulsivity

Impulsivity was assessed by the UPPS-P (Cyders & Smith, 2007). The UPPS-P is a revised version of the UPPS Impulsive Behavior scale (Whiteside & Lynam, 2001). The original UPPS assessed urgency (negative), lack of premeditation, lack of perseverance, and sensation seeking. The UPPS-P adds the dimension of positive urgency. The scale consists of 59 items. Negative urgency refers to a tendency to engage in impulsive behaviors in response to negative effect and is assessed by 12 items, e.g., “When I am upset I often act

without thinking.” Lack of premeditation refers to the absence of consideration of consequences prior to engaging in an act and is assessed by 11 items, e.g., “Before making up my mind, I consider all the advantages and disadvantages”; Reversed. Lack of perseverance assesses an inability to remain focused on boring or difficult tasks and is measured by 10 items, e.g., “I tend to give up easily.” Sensation seeking refers to a tendency to pursue exciting activities and an openness to trying new experiences that are potentially dangerous and is assessed by 12 items, e.g., “I welcome new and exciting experiences and sensations, even if they are a little frightening and unconventional.” Finally, positive urgency refers to a tendency to engage in impulsive behaviors in response to positive effect and is measured by 14 items, e.g., “When I am in a great mood, I tend to get into situations that could cause me problems.” Cronbach's alphas in the present data were 0.89, 0.86, 0.85, 0.87, and 0.94, for negative urgency, lack of premeditation, lack of perseverance, sensation seeking, and positive urgency, respectively.

#### Physical activity

Physical activity was assessed using items from the CDC Behavioral Risk Factor Surveillance System (BRFSS) (Fisher, Spicer, Race, & Melnik, 2003). Participants were asked to report 1) the number of minutes per day they engaged in moderate activities on days when they engaged in moderate activities and 2) the number of minutes per day they engaged in vigorous activities on days when they engaged in vigorous activities. Responses ranged from 0 to 180 min for each item. The BRFSS also includes items regarding how many days per week participants exercise; however, preliminary analyses revealed that frequency was not related to drinking. Moreover, analyses examining exercise frequency for both moderate and vigorous exercise indicated that neither was related to drinking nor did either interact with any dimension of impulsivity in predicting drinking. Thus, the present results focus specifically on amount of exercise per occasion.

#### Drinking

The Daily Drinking Questionnaire (Collins, Parks, & Marlatt, 1985) was used to assess average number of drinks consumed per week over the previous 3 months. Participants were asked, “Consider a typical week during the last 3 months. How much alcohol, on average (measured in number of drinks), do you drink on each day of a typical week?” Participants responded by noting the average number of drinks consumed on each day of the week. Drinks per week was calculated as the sum of responses for each day of the week. This measure has demonstrated good reliability and validity in comparison to other measures of drinking (Borsari & Carey, 2000; Neighbors, Oster-Aaland, Bergstrom, & Lewis, 2006).

## Results

### Relationships between physical activity, drinking, and impulsivity

Means, standard deviations, and correlations for all variables are presented in Table 1. All impulsivity subscales were significantly and positively associated with each other with the exception that sensation seeking was not correlated with lack of premeditation and was negatively correlated with lack of perseverance. Sensation seeking was positively associated with moderate and vigorous physical activity but none of the other impulsivity scales was associated with physical activity. With the exception of lack of perseverance, all of the other impulsivity subscales were positively associated with drinking, at least marginally. In addition, moderate but not vigorous exercise was positively associated with drinking.

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