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Impaired Control over Alcohol Use: An Under-Addressed Risk Factor for Problem Drinking in Young Adults?

Robert F. Leeman, Ph.D.,

Department of Psychiatry, Yale University School of Medicine

Julie A. Patock-Peckham, Ph.D., and

Department of Psychology, Arizona State University

Marc N. Potenza, M.D., Ph.D.

Departments of Psychiatry, Child Study and Neurobiology, Yale University School of Medicine

Abstract

Impaired control over alcohol use may be defined as “a breakdown of an intention to limit consumption in a particular situation” (Heather, Tebbutt, Mattick, & Zamir, 1993, p. 701) and has long been considered an important feature of alcohol dependence. Evidence suggests impaired control is highly relevant to young adult problem drinking. In the natural history of problem drinking, impaired control tends to develop early and may predict alcohol-related problems prospectively in undergraduates. Impaired control over alcohol use may be a facet of generalized behavioral under-control specifically related to drinking. In particular, impaired control is theoretically and empirically related to impulsivity. The question of whether impaired control represents a facet of impulsivity or a related but separate construct requires further study. However, theoretical arguments and empirical evidence suggest that there are unique qualities to the constructs. Specifically, existing data suggest that self-report measures of impaired control and impulsivity over alcohol use relate distinctly to problem drinking indices in young adults. Several lines of future research concerning impaired control are suggested, using the impulsivity literature as a guide. We conclude that impaired control is a valuable construct to the study of young adult problem drinking and that measures of impaired control should be included in more young adult alcohol studies. The extent to which impaired control over the use of other substances and impaired control over engagement in other addictive behaviors are clinically relevant constructs requires additional study.

Keywords

alcohol; alcohol-related problems; college drinking; dopamine; impulsivity

Impaired control over alcohol use constitutes “a breakdown of an intention to limit consumption in a particular situation” (Heather, Tebbutt, Mattick, & Zamir, 1993, p. 701). Difficulty limiting alcohol use may manifest itself as a diminished ability to avoid alcohol use altogether or to control alcohol use once initial consumption has begun (Heather et al., 1993; Kahler, Epstein, & McCrady, 1995). As far back as the 18th century, impaired control has been viewed as an important feature of addictions (Levine, 1978), and continues to

Correspondence concerning this article should be addressed to Robert Leeman, Department of Psychiatry, Yale University School of Medicine, Substance Abuse Center, CMHC, 34 Park Street, Room S200, New Haven, CT 06519; Tel: (203) 974-7373; Fax: (203) 974-7606; robert.leeman@yale.edu.

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occupy a key place in recent definitions. O'Brien, Volkow and Li (2006) defined addiction as “*loss of control* over intense urges to take the drug even at the expense of adverse consequences” (p. 764, emphasis added). Though impaired control pertains to addiction in general (American Psychiatric Association [APA], 2000), research on impaired control over alcohol use is arguably more developed than in other addictive behaviors. Research suggests impaired control’s relevance may extend to younger drinkers, who may not yet be addicted (e.g., Chung & Martin, 2002; Leeman, Toll, Taylor & Volpicelli, 2009; Patock-Peckham, Cheong, Balhorn, & Nagoshi, 2001¹).

Alcohol-related impaired control may be a facet of a more generalized failure of behavioral control specifically related to drinking (Patock-Peckham et al., 2001). In particular, impaired control is theoretically (Bickel & Marsh, 2001) and empirically (e.g., Nagoshi, 1999; Patock-Peckham, King, Morgan-Lopez, Ulloa, & Filson Moses, 2011; Patock-Peckham & Morgan-Lopez, 2006) related to impulsivity, a construct that may be defined as “a predisposition toward rapid, unplanned reactions to internal or external stimuli with diminished regard to the negative consequences of these reactions to the impulsive individual or others” (Brewer & Potenza, 2008; Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001). Impulsivity is a complex, multi-faceted construct with relevance to a wide range of psychiatric conditions including substance use disorders (Moeller et al., 2001). The core components of impulsivity (e.g., choice, response and reflection components, as reviewed in Verdejo-Garcia et al., 2008) have been found to relate differently to various aspects of alcohol involvement and other addictive behaviors (Dick et al., 2010; Verdejo-Garcia et al., 2008; Whiteside & Lynam, 2001). Though the constructs of impaired control and impulsivity are related, data suggest that self-report measures of impaired control over alcohol use and impulsivity relate distinctly to problem drinking indices in young adults. These findings, along with other empirical data and theoretical reasoning, suggest that impaired control and impulsivity represent independent constructs.

The theoretical value of the impaired control construct may be two-fold with these scenarios being non-mutually-exclusive. Impaired control may be one way in which elevated problem drinking risk is manifested in impulsive individuals. Findings in which impaired control partially mediated relationships between impulsivity and alcohol involvement variables among undergraduates support this notion (Leeman, Fenton, Kulesza, Stewart, Taylor, & Copeland, 2009; Patock-Peckham & Morgan-Lopez, 2006; Patock-Peckham, King, Morgan-Lopez et al., 2011). Impaired control may also uniquely capture risk related to behavioral under-control among those who are not considered impulsive in their everyday lives. This possibility is supported by findings that impaired control over alcohol use retained significant relationships with alcohol involvement indices with impulsivity included in the statistical models tested in each of the above studies. These issues will be addressed in detail later in this manuscript.

Progressions of addictions have been characterized by shifts from impulsive, novelty-driven or sensation-seeking behaviors toward compulsive or habit-driven behaviors (Brewer and Potenza, 2008; Dalley, Everitt, & Robbins, 2011; Everitt & Robbins, 2005; Fineberg et al. 2010). As such, impaired control and impulsivity appear applicable to a broad range of addictive processes, both substance- and non-substance-related. At the same time, impaired control and impulsivity may differentially relate to various addictions. For example, impulsivity-related constructs have been closely linked to addictive processes involving

¹Nagoshi, Patock-Peckham and colleagues have utilized the term “drinking control” to refer to the ability to stop drinking (Nagoshi, 1999; Patock-Peckham, Hutchinson, Cheong, & Nagoshi, 1998; Patock-Peckham, Cheong, Balhorn, & Nagoshi, 2001; Patock-Peckham, King, Morgan-Lopez, Ulloa, & Filson Moses, 2011; Patock-Peckham & Morgan-Lopez, 2006). Drinking control is the polar opposite of impaired control and researchers utilizing the term “drinking control” have made use of an impaired control measure valanced in the opposite direction. For consistency, we will utilize only the term “impaired control” throughout the rest of this review.

stimulants, alcohol, cigarettes and gambling and arguably less so to other drug use behaviors (e.g., MDMA/ecstasy) (Verdejo-Garcia, Lawrence, & Clark, 2008). The extent to which relationships between impaired control and other addictive behaviors follow patterns similar to impulsivity and its core components is a topic for future research. Evidence suggests impaired control is relevant to conceptualizations of alcohol use behaviors. Further, alcohol use is an issue of importance to young adult health (Johnston, O'Malley, Bachman, & Schulenberg, 2011; Littlefield & Sher, 2009) and evidence points to a role for impaired control in young adult drinking. Arguably, research on impaired control over other addictive behaviors is not as well developed as it is for alcohol. For these reasons, we will focus this review on impaired control over alcohol use.

The goal of this manuscript is to review relevant theory and data regarding impaired control as a possible risk factor for problem drinking in young adults. The review will begin with a more detailed description of the construct and a brief discussion of its history in the study of addiction, particularly alcoholism. We then present evidence supporting impaired control's relevance to young adult alcohol use behavior. The important issue of impaired control's relationship to impulsivity and other aspects of behavioral under-control is then addressed. In these earlier parts of the review, we focus our attention on issues of relevance to impaired control for which there is empirical support. In a latter section, we outline a non-exhaustive list of topics for future research on impaired control over alcohol use, using the impulsivity literature as a guide. We conclude by considering implications of the material presented.

Background Regarding Impaired Control

Historically, the concept of impaired control has been considered particularly relevant to alcohol use behaviors and disorders (Edwards & Gross, 1976; Jellinek, 1960; Levine, 1978; O'Brien et al., 2006). Impaired control over alcohol use may relate to progression of alcoholism as drinkers may experience difficulty limiting alcohol use early on, which may later be experienced as habitual or compulsive (with an accompanying perceived inability to stop using) with greater alcohol dependence severity (Modell, Mountz, Glaser, & Lee, 1993). Jellinek (1960) made "loss of control" once drinking sessions have begun the defining characteristic of one subtype of alcoholism, the other being defined by an "inability to abstain." Later, Edwards and Gross (1976) included Jellinek's subtypes in their definition of the alcohol dependence syndrome, which more broadly influenced the Diagnostic and Statistical Manual (DSM) substance dependence criteria (see Kahler et al., 1995 for a history of the impaired control construct). Accordingly, two of the seven dependence criteria in the 4th edition text revision of the DSM (DSM-IV-TR, APA, 2000) relate to these aspects of impaired control. Relevant terms pertaining to impaired control are summarized in Table 1.

Taken together, impaired control may be defined as difficulty limiting alcohol consumption despite intent to do so with a diminished ability to avoid alcohol altogether and trouble controlling alcohol use once it has begun representing important components (Heather et al. 1993). Thus the term "impaired control" subsumes Jellinek's two alcoholism subtypes and the two relevant DSM-IV substance dependence criteria (Kahler et al., 1995). Presently, the term "impaired control" is favored over "loss of control," based on the view that control over addictive behaviors is relative, rather than absolute (Heather et al., 1993; Lyvers, 2000).

Competing notions of impaired control as a two-pronged (i.e., difficulty abstaining from and controlling alcohol use once it has begun) and as a unitary construct are a source of complexity in understanding the construct and its assessment. The notion of impaired control having two components has some intuitive appeal. In addition, research in young drinkers has shown noticeably differing rates of endorsement of the two DSM-IV criteria

related to impaired control (e.g., Beseler, Taylor, & Leeman, 2010; Chung & Martin, 2002). However, analyses of various self-report items pertaining to impaired control (Kahler et al., 1995) and research on multiple-item, self-report measures (e.g., the Impaired Control Scale [ICS; Heather et al., 1993] and the impaired control subscale of the Young Adult Alcohol Consequences Questionnaire [YAACQ; Read, Kahler, Strong, & Colder, 2006]) have shown that items assessing difficulty abstaining and controlling alcohol use once it has started tend to be highly correlated. Moreover, self-report items of impaired control have similar relationships to alcohol consumption variables and load onto single factors in factor analyses. These results suggest impaired control is a unitary construct and many individuals who report difficulty abstaining from alcohol also report trouble limiting use once it has started (Kahler et al., 1995). Notably, impaired control is captured in one criterion in the tenth revision of the International Classification of Diseases and Health Problems (ICD-10; WHO, 1992) (Table 1). It is possible that disparities in results may be due, in part, to the subjective element of impaired control contributing more to self-reports (e.g., “I have had an irresistible urge to continue drinking once I started;” “I have found it difficult to resist drinking even for a single day” [ICS; Heather et al., 1993]) than to diagnostic criteria, which may be assessed by clinicians and are often rated in an “all or none” fashion, unlike rating scales, which allow degrees of endorsement. Unless otherwise noted, “impaired control” denotes a unitary construct encapsulating difficulty abstaining and/or controlling alcohol use once it has begun.

Another issue that contributes to complexity in the assessment of impaired control is its subjective component. Intentions to limit alcohol use--entirely (i.e., abstinence) or to a degree (i.e., moderate use)--are inherent in impaired control and introduce a subjective aspect (Kahler et al., 1995; Heather, 1995). Impaired control is not merely a pattern of frequent heavy drinking. Based on a series of analyses, Kahler et al. (1995) concluded “none of the (impaired control-related) items were associated with a particular drinking pattern” (p. 1025). Rather, impaired control is a tendency for alcohol use to run counter to prior plans. This subjective aspect presents a challenge in the measurement of impaired control via self-report (Heather, 1995) and additional challenges when assessing impaired control behaviorally as the same behaviors may reflect different levels of impaired control given differences in intentions. This issue may introduce particular challenges for translational research (e.g., how does one accurately assess limits set in rodents?). Consistently, many of those whose drinking is problematic may not set limits on their drinking behaviors and thus may not endorse impaired control (Chick, 1980).

The traditional retrospective report approach is typical in the assessment of impaired control; thus, an important question is how commonly attempts to limit alcohol use are endorsed by young adults. Sugarman and Carey (2007) found, on average, undergraduates reported using more than half of the drinking control strategies in a self-report measure within the past two weeks. This is consistent with reports from other investigators who have found mean scores on measures of protective strategies to be at about the middle of the possible range of scores (Martens, Martin, Littlefield, Murphy, & Cimini, in press; Palmer, Corbin, & Crouce, 2010). These findings suggest some interest in limiting drinking among undergraduates.

Relevance to Young Adult Problem Drinking

Impaired control may be an important construct in identifying which young drinkers are at risk for problem drinking (Heather et al., 1993). Evidence suggests impaired control may represent a risk factor for problem drinking in general (e.g., Heather et al., 1993), as well as a prospective predictor of alcohol-related problems among young adults (Leeman, Toll et al., 2009). These findings are important to consider from the perspective that neural circuitry

supporting higher order self-regulation tends not to be fully developed in adolescents (Bava & Tapert, 2010; Casey, Duhoux, & Cohen, 2010; Chambers, Taylor, & Potenza, 2003; Rutherford, Mayes, & Potenza, 2010) and undergoes changes through young adulthood (Wiers et al., 2007).

Young adult heavy drinking is a public health concern. According to the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC), 39% of 18-to-25-year-olds reported heavy episodic drinking at least once in the past month (Harrison, Desai, & McKee, 2008). This level of alcohol consumption is related to serious consequences, such as traffic accidents (Hingson, Zha, & Weitzman, 2009; Yi, Williams, & Smothers, 2004). While many young adults will “mature out” of heavy use by their mid-to-late twenties, a minority will continue heavy use and may encounter clinically significant problems (Jackson, Sher, Gotham, & Wood, 2001). Thus, additional research is needed to determine which young adults may be at heightened risk of negative outcomes (Littlefield & Sher, 2009).

Impaired control over alcohol use emerges relatively early in the natural history of problem drinking (Heather, 1995). Alcoholic adults asked to recount which dependence symptoms developed the earliest frequently cite impaired control (Chick & Duffy, 1979; Langenbucher & Chung, 1995). In adolescents, 93.5% of those meeting DSM-IV alcohol dependence criteria endorsed the “larger/longer” criterion and 58.1% endorsed the “quit/control” criterion (Table 1) (Martin, Kaczynski, Maisto, Bukstein, & Moss, 1995). In a high-risk community sample of adolescent and young adult drinkers, “larger/longer” was the alcohol use disorder (i.e., alcohol abuse or dependence) criterion most likely to be endorsed first (32.9%) and to have lifetime endorsement (61.1%). “Quit/control” was also relatively common (first symptom: 19.2%, lifetime: 34.9%) (Buu, Wang, Schroeder, Kalaida, Puttler, & Zucker, in press). In a general community sample of adolescents and young adults in Germany, “larger/longer” and “quit/control” were the third and fourth most commonly endorsed dependence criteria (3.4% and 3%, respectively). For comparison, tolerance was the most common at 13.1% (Behrendt et al., 2008). In a sample of undergraduates with lifetime alcohol exposure, the “larger/longer” criterion was the second most commonly endorsed in the past year (by 34.8%) after tolerance (45.6%). “Quit/control” was endorsed less frequently (9.6%) (Beseler et al., 2010). Roughly similar endorsement was found in another recent sample of undergraduate current drinkers: “larger/longer”: 43.7%, “quit/control”: 8.1% (Hagman & Cohn, 2011).

Impaired control is relevant to young adult problem drinking via (1) alcohol-related problems (i.e., negative consequences of alcohol use and dependence symptoms [White & Labouvie, 1989]) and (2) heavy use. Heavy patterns could include “heavy episodic drinking,” defined as five or more drinks on one occasion for males, four or more for females (Wechsler, Moeyknes, Davenport, Castillo, & Hansen, 1995), or “binge drinking,” defined as heavy episodic drinking occurring within two hours or less (NIAAA, 2004). Difficulty limiting alcohol consumption may lead to heavy drinking in many cases (Leeman, Fenton, & Volpicelli, 2007). In addition, individuals with difficulty controlling their alcohol use will likely fail to constrain their drinking sufficiently to avoid negative consequences (Patock-Peckham et al., 2001).

Significant relationships have been reported between impaired control and alcohol involvement in adolescents and young adults (Table 2). Impaired control has been implicated in the development of alcohol dependence in longitudinal studies involving adolescents and young adults. Buu et al. (in press) concluded that early “quit/control” onset was indicative of an initial stage of alcohol dependence in a high-risk sample of adolescents and young adults. Behrendt et al. (2008) found that early “larger/longer” onset was

associated with elevated risk of alcohol dependence in a German community sample. Impaired control self-reports have also been incorporated into statistical models with other key variables and have predicted unique variance in alcohol involvement among undergraduates (Table 2). ICS scores during freshman year predicted frequency of heavy episodic drinking and alcohol-related problems cross-sectionally (Leeman, Fenton, et al., 2007) and alcohol-related problems prospectively during senior year in a model including several other predictor variables including drinks per week, gender, sensation seeking and expectancies of alcohol's disinhibiting effects. ICS scores showed moderate stability from freshman to senior year (Leeman, Toll, et al., 2009). In another study, ICS scores significantly predicted alcohol-related problems but not alcohol consumption in cross-sectional regression models (Nagoshi, 1999). In two other studies, ICS scores predicted alcohol-related problems and alcohol consumption in cross-sectional path models (Patock-Peckham et al., 2001; Patock-Peckham & Morgan-Lopez, 2006). In the latter study, impaired control's relationship to alcohol-related problems was somewhat stronger than its relationship to alcohol use (Patock-Peckham & Morgan-Lopez, 2006).

In summary, impaired control has been associated with alcohol consumption and related problems among young adults. Relationships to alcohol-related problems have been particularly strong in several studies. Notably, impaired control has predicted unique variance in problem drinking indices in statistical models including several other predictors of drinking outcomes.

Relationships between Impaired Control and Impulsivity

Theory, self-report and limited pharmacologic evidence suggest that impaired control and impulsivity are related. Impaired control could theoretically represent another facet of impulsivity. While the term "impulsivity" has at times been used and defined loosely, more recently it has been fractionated into specific components, such as response and choice forms (Dalley et al., 2011; Dick et al. 2010; Potenza & de Wit 2010; Winstanley, Theobald, Dalley, & Robbins, 2004). Response impulsivity has been defined as deficient inhibitory control over reinforcing thoughts and behaviors (Verdejo-Garcia et al., 2008). Choice impulsivity has been defined as a tendency to select immediate rather than delayed or probabilistic benefits (Green & Myerson, 2009). A component of impulsivity involving diminished reflection has also been described, defined as a failure to gather and evaluate information optimally before making a decision (Kagan, 1966; Verdejo-Garcia et al., 2008). Within these domains, self-report and behavioral assessments may not correlate significantly (Krishnan-Sarin et al., 2007; Reynolds, Ortengren, Richards, & de Wit, 2006), suggesting that how individuals react hypothetically and in real-life situations may vary. Given that the focus of the present review is on impaired control and since the construct of impulsivity and its relationship to alcohol involvement has been addressed thoroughly in several reviews cited above, a full review of impulsivity is outside the scope of this manuscript.

There are theoretical commonalities between impaired control over alcohol use and impulsivity that likely apply to multiple facets of the impulsivity construct. Impaired control and impulsivity both involve difficulties maintaining control. Both constructs involve action despite possible negative consequences. This is reflected in the aforementioned definition of impulsivity (Brewer & Potenza, 2008; Moeller et al., 2001) and empirical relationships among young adults between self-reported impaired control and alcohol-related problems (Table 2). Theoretically, impaired control may be considered a facet of impulsivity with impaired control representing a manifestation of impulsivity in the alcohol use/abuse realm (Patock-Peckham & Morgan-Lopez, 2006; Patock-Peckham et al., 2001) and potentially, in the use and abuse of other substances.

Cross-sectional evidence in adolescents and undergraduates indicates significant, small-to-moderate relationships between impaired control and measures tapping into response and reflection impulsivity (correlations typically in the 0.20–0.30 range) (Table 3). Most of these studies utilized samples of current alcohol users. To date, three self-report measures have been utilized in this research: the impulsiveness subscale of the Eysenck Personality Questionnaire, version 7 (I.7; Eysenck, Pearson, Easting, & Allsopp, 1985); the Barratt Impulsiveness Scale, version 11 (BIS-11; Patton, Stanford, & Barratt, 1995) and the UPPS Impulsive Behavior Scale, original version (Whiteside & Lynam, 2001). Dick et al. (2010) equated the negative urgency subscale of the UPPS with the attentional impulsiveness subscale of the BIS-11. Arguably, both pertain to response impulsivity while some negative urgency items arguably pertain to reflection impulsivity as well. Similarities between the Eysenck measure and the motor and nonplanning subscales of the BIS-11 have been noted previously (Patton & Stanford, 2012). These measures arguably relate primarily to reflection impulsivity.

Limited pharmacologic evidence suggests relationships between impaired control and choice, response and reflection impulsivity. Modell, Mountz and Beresford (1990) proposed impaired control may be triggered by impairment of inhibitory mechanisms in the striatum resulting from acute dopamine release following alcohol use. Modell et al. (1993) obtained some evidence supporting this position from a study of alcohol administration/self-administration following injection of the D2-like receptor antagonist haloperidol or saline in alcohol dependent individuals of varying ages who self-reported frequent impaired control. Following haloperidol, participants reported significantly less impaired control (difficulty resisting an alcoholic beverage if offered) following a priming drink of alcohol than when the priming drink followed saline. After the priming drink, participants were allowed to self-administer additional alcohol. Fewer subsequent drinks were consumed following haloperidol than following saline. Dopaminergic activity has also been tied to response and choice impulsivity (Jentsch & Taylor, 1999). Reduced dopamine D2/D3 (“D2-like”) receptor availability has been related to higher overall BIS-11 (Patton et al., 1995) scores (Buckholtz et al., 2010). Similarly, in rats, impulsive response on an attentional task was associated with lower striatal D2-like receptor binding (Dalley et al., 2007). These findings parallel observations that continued seeking and taking of substances may involve reduced D2-like receptor availability (Volkow, Fowler, & Wang, 2003). Dopaminergic activity has also been hypothesized to contribute to greater delay discounting (i.e., devaluation of distal compared with more immediate rewards) in those with substance use disorders (Schultz, 2011). High concentrations of dopamine in subcortical areas are associated with rapid, dominant, approach responses, while high concentrations in the cortex may serve to weaken inhibitory control and increase response impulsivity. As Jentsch & Taylor (1999) and others (e.g., Arnsten, 2007) have argued, homeostatic dopamine levels in specific brain regions may influence cognitions and behaviors, including those involving self-control, such that levels that are too high or too low are suboptimal. Given negative results for dopamine antagonists in alcohol dependence treatment (Walter, Ramskogler, Semler, Lesch, & Platz, 2001), one should be careful in considering dopaminergic contributions to alcoholism, particularly as potential targets for treatment development. Nonetheless, these findings suggest a role for dopaminergic activity in impaired control over alcohol use and in multiple forms of impulsivity.

While impulsivity and impaired control over alcohol use are related constructs, theoretical arguments and empirical evidence suggest there are also unique qualities to the constructs. These theoretical arguments likely apply to multiple forms of impulsivity as well. While impulsivity is a general tendency that can affect myriad aspects of an individual’s life, impaired control as defined here represents a tendency toward dysregulated response to alcohol use specifically (Patock-Peckham, King, Morgan-Lopez et al., 2011) and possibly

addictive behaviors by extension. Accordingly, those with impaired control over alcohol use may not be impulsive in general. There are other examples of individual difference variables related to alcohol response. For instance, evidence suggests non-dependent heavy drinkers tend to self-report greater stimulation than non-dependent lighter drinkers, particularly on the ascending limb of the blood-alcohol curve² (Quinn & Fromme, 2011).

Another theoretical distinction between impulsivity and impaired control over alcohol use concerns the limit setting aspect of impaired control. While impaired control entails lack of adherence to an intention to limit drinking behavior, with impulsivity there need not ever be any intent to limit behavior (Bickel & Marsch, 2001). Even if limit setting among those with impaired control over alcohol use tends not to be successful ultimately, this inclination toward self-regulation may distinguish it from impulsivity.

Existing data suggest that self-reported impaired control over alcohol use and forms of impulsivity each have clinically relevant, distinct relationships to problem drinking indices in young adults. In studies of undergraduates, statistical models suggest partial mediation of relationships between self-reported Eysenck I.7 scores (Eysenck et al., 1985) and alcohol use (Patock-Peckham & Morgan-Lopez, 2006) and between Eysenck I.7 scores and alcohol-related problems (Patock-Peckham & Morgan-Lopez, 2006; Patock-Peckham, King, Morgan-Lopez et al., 2011) by impaired control. Similarly, impaired control partially mediated relationships between total score on the BIS-11 and binge drinking frequency and, in separate analyses, between alcohol-related problems and the BIS-11 total score, and specifically with the attentional and nonplanning BIS-11 subscales (Leeman, Fenton et al., 2009). Evidence of partial mediation suggests that for some young adult drinkers, impaired control may be a mechanism underlying the relationship between impulsivity and alcohol involvement. Thus, impaired control may be one way in which problem drinking risk is manifested in impulsive individuals. At the same time, significant, direct relationships between impulsivity and alcohol involvement remained in these models. Impaired control was a significant predictor of alcohol involvement variables with impulsivity included in the model as well. This pattern of findings suggests that while impulsivity and impaired control are related (Table 3), they make unique contributions to alcohol use and related problems. The question of whether impaired control represents a facet of impulsivity or a separate but theoretically related construct requires further study.

While impulsivity is arguably the aspect of behavioral under-control (see Sher & Trull, 1994) that is the most relevant to impaired control over alcohol use, other constructs are also potentially relevant. Two constructs—self-regulation and sensation seeking—have been studied in relationship to impaired control. Self-regulation has been defined as a tendency to be able to plan and conduct efforts to achieve adaptive goals, often requiring delayed gratification (Hustad, Carey, Carey, & Maisto, 2009). Low impaired control was found to mediate negative relationships between generalized self-regulation and both alcohol use and alcohol-related problems in undergraduates (Patock-Peckham et al. 2001). There is also limited evidence that impaired control is related to sensation seeking, defined as “the seeking of varied, novel, complex, and *intense* sensations and experiences, and the willingness to take physical, social, *legal*, and *financial* risks for the sake of such experiences” (Zuckerman, 1994, p. 27, emphasis in original). Leeman, Toll et al. (2009) found moderate, significant cross-sectional correlations between impaired control and sensation seeking at Time 1 (freshman year) and Time 2 (senior year) of a prospective study.

²The ascending limb of the blood alcohol curve reflects when more alcohol is being absorbed into the blood stream than is being excreted from the body. Typically, this denotes the first 20–30 minutes of consumption when most individuals experience the stimulating effects of alcohol. In contrast, the descending limb of the blood alcohol curve reflects when alcohol is being excreted at a faster rate than it is being absorbed into the blood. Typically, the descending limb is characterized by the depressant effects of alcohol consumption and may last for several hours depending upon peak blood alcohol concentration (McKim, 2006).

Patock-Peckham, King, Backer-Fulghum et al. (2011) reported no significant path from sensation seeking to impaired control in a structural equation model involving undergraduate survey data. In summary, impaired control may relate to behavioral under-control constructs besides impulsivity, but relatively few results are available.

Pertinent Research Questions Concerning Impaired Control over Alcohol Use

While we have some knowledge of relationships between self-reported impaired control and problem drinking in young adults and about relationships between impaired control and self-reported impulsivity, a number of key questions have yet to be addressed. After examining the relevant literature on impaired control over alcohol use and impulsivity, we arrived at the list of research questions that will be addressed in this section. Data addressing these outstanding questions could potentially enhance our understanding of impaired control. Given the importance of impaired control to problem drinking risk in young adults, data pertaining to these questions could also improve our understanding of problem drinking risk and treatment in this population. Research on impulsivity has advanced a great deal, in part through the use of a wide variety of research approaches including self-reports, laboratory measures, neuroimaging and animal models (see Verdejo-Garcia et al., 2008, for a review). The impulsivity literature will be used as a guide in outlining some key research questions concerning impaired control over alcohol use.

Is Laboratory/Translational Research Concerning Impaired Control Possible?

Impulsivity research has benefitted from human and animal laboratory studies. In human laboratory studies, many of which have involved young adults, participants have been administered different doses of alcohol and then tested with various tasks indicative of response (e.g., Fillmore, 2004; de Wit, Crean, & Richards, 2006) and choice impulsivity (Reynolds et al., 2006). Impulsive task performance following alcohol administration has also been tested as a predictor of *ad libitum* consumption (i.e., the participant chooses how much alcohol to have within certain limits) in a subsequent session (Weafer & Fillmore, 2008). A recent series of studies has shown that young adults can be primed or trained to respond in a disinhibited or inhibited fashion, and that these states relate to increased and decreased subsequent alcohol consumption, respectively (Houben, Nederkoorn, Wiers, Jansen, 2011; Jones, Guerrieri, Fernie, Cole, Goudie, & Field, 2011). Animal models have offered valuable results, including high-ethanol-preferring mice making more impulsive choices on a delay-discounting (i.e., choice impulsivity) task than low-ethanol-preferring mice (Oberlin & Grahame, 2009). Animal models have also demonstrated that alcohol can increase impulsive choices. This choice pattern was predictive of greater subsequent *ad libitum* ethanol consumption (Poulos, Parker, & Le, 1998).

A human laboratory model of impaired control could be developed in which participants are allowed to self-administer alcohol in a manner that adheres to or violates a limitation, which would be associated with alternate reinforcement or punishment (e.g., gain or loss of money). Translational alcohol research is of great value (Crabbe, 2010; Leeman, Heilig, Cunningham, Stevens, Duka, & O'Malley, 2010); however, development of an accompanying animal model could be complex given that a limit on alcohol use cannot be conveyed directly to or by animals. Perhaps animals could be trained to self-administer alcohol first and then subsequently, a punishment for greater than moderate consumption or an alternate reward (e.g., food) for adhering to moderate levels could be introduced. An animal's lack of ability to drink moderately could be indicative of impaired control. However, the extent to which such models could distinguish impaired control from choice impulsivity warrants careful consideration.

Testing animals and humans on both the ascending and descending limb of the blood alcohol curve would be important given findings that some effects of alcohol (e.g., stimulant and sedative effects; Quinn & Fromme 2011) may be relatively stronger or weaker dependent upon the limb of the curve. Alcohol-related cognitive and behavioral impairment has also been found to differ based on limb of the blood alcohol curve in young adults (Ostling & Fillmore, 2010). These factors have all been found to relate to amount of alcohol consumed and consequently may be relevant to impaired control over alcohol use.

These types of laboratory models would be valuable for multiple reasons. Such models would be helpful in further elucidating relationships between impaired control and impulsivity (see below) and for testing, on a preliminary basis, treatments (i.e., pharmacotherapies in animals and humans and counseling modalities in humans) that may ameliorate impaired control over alcohol use. Laboratory models would also offer a means of testing relationships between impaired control and variables pertaining to alcohol-related reinforcement. These include craving (Addolorato et al., 2005; Rodd, Bell, Sable, Murphy, & McBride, 2004), cue-induced alcohol consumption (Cooney, Litt, Morse, Bauer, & Gaupp, 1997; Pickering & Liljequist, 2003), alcohol priming effects (de Wit 1996; 2000), stimulant effects of alcohol (Crabbe, Bell, & Ehlers, 2010; Morean & Corbin, 2010) and consumption in response to stress (Sinha, 2001; Volpicelli, 1987) for both humans and animals and alcohol-related expectancies (Jones, Corbin, & Fromme, 2001) and motives (Cooper, Russell, Skinner, & Windle, 1992) for humans. Given their reinforcing qualities and relationships to increased alcohol use, relevance of these variables to impaired control seems likely. These variables could be assessed in the course of laboratory studies should such models of impaired control be developed. Lastly, unlike cross-sectional self-report studies, research involving laboratory models can be used to draw conclusions regarding impaired control as a cause of alcohol use in general and rapid or heavy use, in particular.

How Does Impaired Control Relate to Laboratory Measures of Impulsivity?

Alcohol use has been found to increase both response and choice impulsivity (Dick et al., 2010; Perry & Carroll, 2008; Verdejo-Garcia et al., 2008). One or more of these cognitive effects may increase the likelihood of impaired control over alcohol use. The effect of even small-to-moderate doses of alcohol (equivalent to one or two drinks; Weafer & Fillmore, 2008) on response impulsivity (Fillmore, 2004; Marczinski, Abroms, Van Selst, & Fillmore, 2005; de Wit, Crean, & Richards, 2006; Marczinski & Fillmore, 2005b; Mulvihill, Skilling, & Vogel-Sprott, 1997; Ostling & Fillmore, 2010; Perry & Carroll, 2008) may make it difficult for some drinkers to ignore salient, alcohol-related cues (Bechara, 2005; Bond, 1998; Field et al., 2010) or resist urges to drink further (de Wit, 2000). It is potentially problematic that behavioral activation (i.e., appetitive, approach behaviors, see Carver & White, 1994; Gray, 1987; Houben et al., 2011; Wiers et al., 2007) remains relatively stable following low-to-moderate alcohol doses (de Wit et al., 2000; Gauggel et al., 2010; Marczinski & Fillmore, 2005a; Miller & Fillmore, in press; Mulvihill et al. 1997), while inhibitory control declines (Weafer & Fillmore, 2008). Accordingly, one's ability to seek alcohol may remain intact while the ability to inhibit this impulse and maintain limits on alcohol use may be compromised. Further, alcohol's negative effects on controlled, effortful cognitive processes (Abroms, Gottlob, & Fillmore, 2006; Giancola, Josephs, Parrott, & Duke, 2010) may make it difficult for some drinkers to utilize cognitions that facilitate controlled drinking (e.g., moderate drinking strategies, reasons for limiting drinking) (Finn & Hall, 2004). Animal and human evidence suggests that accentuation of choice impulsivity may require higher alcohol doses than response impulsivity (Poulos et al., 1998; Reynolds et al., 2006). Thus, after consumption of greater quantities of alcohol, longer-term consequences could be ignored in favor of more immediate rewards related to alcohol use.

Future research could examine relationships between these cognitive impairments and impaired control over alcohol use directly, with the use of laboratory measures of impulsivity. Several different types of studies could be conducted. Correlational studies would provide some insight into the magnitude of relationships between self-reported impaired control and performance on tasks assessing response impulsivity (e.g., go/no-go and stop-signal tasks) and impulsive choice (e.g., delay-discounting tasks). These laboratory measures could also be incorporated into alcohol administration studies. Following baseline completion of an impaired control self-report and a battery of laboratory measures, an approach similar to that of Modell et al. (1993) could be utilized. A priming dose of alcohol could be administered followed by a rating of impaired control (i.e., perceived difficulty in limiting consumption should more alcohol be offered) and completion of the same laboratory measure(s). Changes in self-reported impaired control could be related to decrements in task performance following alcohol administration. Again, like Modell et al., subsequent *ad libitum* consumption could be offered, followed by additional impaired control ratings and laboratory measure completion. This added step would allow for examination of relationships between further changes in task performance and patterns of consumption potentially indicative of impaired control. Tasks assessing impulsive choice or response could be incorporated into studies utilizing human and animal laboratory models of impaired control, should those be developed. This would allow for possible translational research to explore further relationships between impaired control and core components of impulsivity.

Is Impaired Control a Longitudinal Predictor of Problem Drinking?

Longitudinal research has determined that impulsivity and related constructs assessed during childhood are predictive of subsequent problem drinking in late adolescence/early young adulthood (Mezzich, Tarter, Feske, Kirisci, McNamee, & Day, 2007) and late young adulthood (Hicks, Iacono, & McGue, 2010). In an adult sample of non-dependent, heavy drinkers (baseline mean age of 37.7 years), high self-reported impulsivity on the BIS-11 (Patton et al., 1995) and longer stop-signal reaction times on a stop-signal task (Logan, 1994) were predictive of elevated risk for development of alcohol dependence at a 4-year follow-up (Rubio et al., 2008).

There is limited evidence supporting impaired control as a prospective predictor of problem drinking in a community sample of adolescents/young adults (Behrendt et al., 2008) and in undergraduates (Leeman, Toll et al., 2009). The impaired control subscale of the YAACQ predicted frequency of any alcohol consumption and heavy alcohol use in a short-term prospective study (Read et al., 2007). There is also one prospective, intervention study finding in young adults (see below) of which we are aware. These findings suggest that self-reported impaired control assessed relatively soon after onset of alcohol consumption (e.g., during adolescence) may predict problem drinking subsequently. However, more long-term longitudinal studies are needed in order to make definitive conclusions regarding the possibility that impaired control over alcohol use may have a causal role in subsequent problem drinking.

Can Impaired Control Be Reduced in the Course of Alcohol Treatment?

While impaired control measures are arguably under-utilized in young adult alcohol studies in general, when they are included it is typically as a predictor (e.g., Nagoshi, 1999; Leeman, Toll et al., 2009) or as a mediating variable along the alcohol-related problems pathway (Patock-Peckham et al., 2001; Patock-Peckham & Morgan-Lopez, 2006; Patock-Peckham et al., 2011). Yet, there is scant evidence regarding impaired control as an outcome in young adult alcohol research. This pattern parallels the historical use of impulsivity constructs; however, recent studies have suggested that self-reported impulsivity may

change over time (Littlefield, Sher, & Wood, 2010) and that both self-report and behavioral measures of impulsivity may change during treatment (Blanco et al., 2009; Grant, Chamberlain, O'Leary, Potenza, Kim, 2010; Potenza, Sofuoglu, Carroll, & Rounsaville, 2011) and thus might represent important treatment targets for addiction research. In correlations and cross-sectional models, several variables relate to impaired control in young adults including alcohol-related expectancies (Nagoshi, 1999; Leeman, Toll et al., 2009) and motives (Leeman, Fenton et al., 2007). The testing of models utilizing treatment and other prospective data to predict impaired control would allow for more definitive determinations of which variables are related to impaired control and which may predict its onset. Research regarding which variables concerning alcohol-related reinforcement (e.g., craving, stimulant effects) predict impaired control may be particularly important.

Interventions designed for young adult heavy drinkers, such as Brief Alcohol Screening and Intervention for College Students (BASICS; Dimeff, Baer, Kivlahan, & Marlatt, 1999), attempt to enhance drinking control. Thus, impaired control may represent an important alternate outcome measure for studies testing such interventions. Accordingly, YAACQ impaired control subscale scores decreased significantly in incoming undergraduates one month after a brief, web-based intervention, in comparison with an assessment-only control (Hustad, Barnett, Borsari, & Jackson, 2010). Another clinical implication is that endorsement of "problems with controlling drinking" predicted interest in an alcohol reduction clinical trial involving opiate antagonist naltrexone in a university survey (Leeman, Corbin, Fucito, Urwin, & O'Malley, 2011).

How Is Impaired Control Initiated During a Drinking Session?

Self-reported impaired control relates to various measures of alcohol involvement in young adults (see Table 2). Currently, little is known regarding how impaired control becomes activated during a drinking session. Modell et al. (1993) showed increases in self-reported impaired control following initial drink consumption; however, little is known about the manner in which various factors act separately or in combination to increase or decrease impaired control. Relevant variables include cognitive impairments triggered by alcohol use (see above), social/interpersonal factors (e.g., peer pressure), academic or work demands (e.g., having/not having an early work day or exam the next day); aspects of the environment (e.g., availability of a designated driver); behavioral economic factors (e.g., cost of alcohol) and religiosity. Human and animal laboratory models could be utilized to address at least some of these factors in "real time." Ecological momentary assessment techniques (see Shiffman, Stone, & Hufford, 2008) in humans could also enable relevant data collection "in the field" during drinking sessions.

What Regions of the Brain and Neurotransmitter Systems Tend To Be Compromised?

Little work has been done to relate impaired control directly to brain function or neurotransmitter systems, with the exception of Modell and colleagues' work (1990; 1993) concerning relationships between dopaminergic function and impaired control. Research on impulsivity and research linking alcohol use to particular neurotransmitters or brain regions may help guide future research. Reviewing the multiple neurotransmitter systems and brain regions relevant to impulsivity and substance use and addiction is outside the scope of this manuscript (see Brewer & Potenza, 2008; Verdejo-Garcia et al., 2008 for recent reviews). Briefly, multiple neurotransmitter systems (e.g., dopaminergic, serotonergic, noradrenergic, glutamatergic, and opioidergic) have been implicated in impulsivity and addictions, and multiple neural systems involving cortical, subcortical and/or limbic structures appear relevant to impulsivity and addictions. Specifically, structural (e.g., volumetric), functional (involving functional magnetic resonance imaging), ligand-based (e.g., using positron emission tomography), and white matter (e.g., diffusion tensor imaging) studies have linked

impulsivity to brain structure/function to impulsivity and addictions, and these studies provide a framework to test how impaired control might relate to different stages and extents of alcohol use.

Criticisms and Implications Regarding Impaired Control

Evidence suggests impaired control is particularly relevant to young adult drinkers. The prevalence of reports of impaired control by young drinkers with relatively brief drinking histories and by those who do not drink excessively has raised concerns that impaired control may not consistently reflect compulsive use indicative of addiction (Caetano, 1999; Chung & Martin, 2002; 2005). Caetano (1999) analyzed reasons for endorsement of DSM-IV alcohol dependence criteria by adult current drinkers in two national samples and expressed concern due to frequent attribution of social motives underlying endorsement of both impaired control criteria. Among adolescents in addiction treatment programs, Chung and Martin (2005) also found frequent attribution of social factors underlying “larger/longer” endorsement.

Impaired control is often endorsed by young people who do not drink compulsively, and this may reflect impaired control’s value as an early predictor of problem drinking. More specifically, impaired control may relate to progression of alcoholism as drinkers may experience difficulty limiting alcohol use early on, which may later be experienced as habitual or compulsive (Modell et al., 1993). It may be that the majority of problem drinking young adults are at this earlier stage in which they are beginning to experience some difficulty limiting their use, but have not yet reached compulsive or addictive use. This also fits with the modern notion of impaired control as being on a continuum, not absolute (Heather et al., 1993; Lyvers, 2000).

While attribution of social motives to the endorsement of impaired control may be viewed as concerning, the aforementioned findings of impaired control accounting for unique variance in alcohol involvement and problem drinking indices (see Table 2) argues against substantial confounding by social motives and other related variables. According to Caetano (1999), part of the reason for concern regarding social motives is that these motives tend not to typify compulsive drinking. In young adults, a great deal of high-risk drinking occurs in social contexts. Drinking games (Borsari, 2004) and extreme binge drinking as part of 21st birthday celebrations (Rutledge, Park, & Sher, 2008) are two examples. Therefore, drinking attributed to social factors should not be dismissed as non-problematic, especially among young adults.

In conclusion, impaired control is a valuable construct to the study of young adult problem drinking. In the natural history of problem drinking, impaired control appears to be one of the earliest symptoms to develop. The question of whether impaired control over alcohol use most appropriately represents a facet of impulsivity or a separate but related construct requires further research. However, data suggest that self-report measures of impaired control have clinically relevant, distinct relationships to problem drinking indices in young adults as compared to multiple self-report measures of impulsivity. Despite these data, structured measures of impaired control are infrequently used in alcohol studies of young adults. At a minimum, existing data suggest that impaired control should be assessed routinely in studies as a possible predictor, mediator and/or outcome variable, particularly in studies involving young adults. Given the brief length of reliable, valid self-report measures (e.g., the ICS and the impaired control subscale of the YAACQ), assessment of impaired control is also practical.

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Table 1

Relevant Terms Concerning Impaired Control over Alcohol Use

Aspect of impaired control	Exact wording of DSM-IV criteria (APA, 2000, p. 197)	Common shorthand for DSM-IV criteria	Exact wording of ICD-10 criterion (WHO, 1992, p. 75)	Terminology from Jellinek's conceptualization
Difficulty controlling alcohol use once it has started	The substance is often taken in larger amounts or over a longer period than was intended	Larger/longer	Difficulties in controlling substance-taking behaviour in terms of its onset, termination, or levels of use	Loss of control
Difficulty avoiding alcohol use altogether	There is a persistent desire or unsuccessful efforts to cut down or control substance use	Quit/control	Included in above criterion	Inability to abstain

Table 2
Relationships between Self-Reported Impaired Control and Alcohol Involvement in Adolescents and Young Adults

Authors	Yr	Sample	IC measure	Alcohol variables/comparison	Summary of IC findings
Behrendt et al. *	08	Community sample in Germany	DSM-IV criteria (Table 1), via interview	Alcohol dependence diagnosis	"Larger/longer" onset in general and early onset in particular were associated with increased risk of development of alcohol dependence
Buu, Wang, Schroeder, Kalaïda, Puttler, & Zucker *	IP	High-risk community sample first assessed during childhood	DSM-IV criteria, via interview	Alcohol dependence diagnosis	Having "quit control" or "larger/longer" as one's first AUD symptom conveyed no unique risk of alcohol dependence in a regression model. However, based on the pattern of "quit/control" onset over time, it was thought to be indicative of an initial stage of alcohol dependence.
Chung & Martin	02	Adolescents clinical setting & community	DSM-IV criteria, via interview	Drinks per occasion Freq alcohol use Freq heavy episodic drinking ADS score	Moderate, significant correlations between both criteria and all alcohol variables, except for a small, significant correlation between 'quit/control' and frequency of alcohol use.
Hustad, Barnett, Borsari, & Jackson *	10	First-year undergrads	YAAQCQ IC	Comparison between brief alcohol intervention & control	Significantly larger decrease in IC in intervention compared to control
Leeman, Corbin, Fucito, Urwin, & O'Malley	11	Undergrads, alcohol users	Single item self-report	Interest in clinical trial involving naltrexone	Significant relationship to clinical trial interest
Leeman, Fenton, & Volpicelli	07	First-year undergrads, alcohol users	ICS, Part 2	Freq heavy episodic drinking Alcohol-related problems	Significant predictor of both variables in regression models
Leeman, Toll, Taylor, & Volpicelli *	09	T1: First-yr undergrads, alcohol users T2: Senior-yr	ICS, Part 2	Freq heavy episodic drinking Alcohol-related problems	Significant predictor of alcohol-related problems but not of heavy drinking in prospective regression models.
Nagoshi	99	Undergrads, alcohol users	ICS, Part 3	Quantity/freq alcohol use Alcohol-related problems	Significant predictor of alcohol-related problems, but not of alcohol use in regression models
Oddy & Barry	09	Undergrads, alcohol users	ICS—all parts	Comparison between heavier and lighter social drinkers	Heavier social drinkers scored significantly higher
Palfai & Ostafin	10	Hazardous drinkers ($M = 22.5$ yrs)	ICS, Parts 2 & 3	Past month drinking quantity	Moderate, significant partial correlations holding gender constant
Patock-Peckham, Cheong, Balhorn, & Nagoshi	01	Undergrads, alcohol users	ICS, Part 3	Quantity/freq alcohol use Alcohol-related problems	Significant predictor of both variables in path models
Patock-Peckham, Hutchinson, Cheong & Nagoshi	98	Undergrads, alcohol users	ICS, Part 3	Alcohol-related problems Freq alcohol use, freq inebriation, quantity of use	Large, significant correlation with alcohol-related problems; small, significant correlation with frequency of use; moderate, significant

Authors	Yr	Sample	IC measure	Alcohol variables/comparison	Summary of IC findings
Patock-Peckham, King, Morgan-Lopez, Ulloa & Filson-Moses	11	Undergrads	ICS, Part 3	Alcohol-related problems	correlations with inebriation and quantity of use
Patock-Peckham & Morgan-Lopez	06	Undergrads, alcohol users	ICS, Part 3	Quantity/freq alcohol use Alcohol-related problems	Significant predictor in path models
Read, Beattie, Chamberlain, & Merrill	08	Undergrads, alcohol users	YAAQCQ IC	Comparison between heavier and lighter drinkers	Significant predictor of both variables in path models, relationship to alcohol-related problems stronger
Read, Kahler, Strong, & Colder	06	Undergrads, alcohol users	YAAQCQ IC	Freq any & heavy episodic use Alcohol-related problems	Heavier drinkers scored significantly higher than lighter drinkers
Read, Merrill, Kahler, & Strong *	07	Undergrads	YAAQCQ IC	Freq any & heavy episodic use Quantity of alcohol use	Significant correlations with all variables, magnitude not reported

Note. Results from the most sophisticated statistical test reported are included in table.

* indicates prospective study, all other studies cross-sectional.

Small correlation ($r =$ up to 0.29), moderate correlation ($r = 0.30-0.49$), large correlation (0.50 or higher). Yr = year, IC = impaired control, IP = in press, AUD = alcohol use disorder (i.e., alcohol abuse or dependence), ADS = Alcohol Dependence Scale (Skinner & Allen, 1982), ICS = Impaired Control Scale, YAAQCQ IC = impaired control subscale of Young Adult Consequences Questionnaire, freq = frequency of, T1 = time 1, T2 = time 2. Part 2 of the ICS assesses past difficulties limiting alcohol use. Part 3 of the ICS measures beliefs about future difficulties.

Table 3
Relationships between Self-Reported Impaired Control and Impulsivity in Adolescents and Young Adults

Authors	Yr	Sample	IC scale	Impulsivity scale	Summary of findings
Chung & Martin	02	Adolescents: clinical setting & community	DSM-IV criteria, via interview	Eysenck I.7	Moderate, significant correlation between "larger/longer" criterion & impulsivity. Non-significant correlation between impulsivity and "quit/control"
Leeman, Fenton, Kulesza, Stewart, Taylor, & Copeland	09	Undergrads, alcohol users	ICS, Part 2	BIS-11	Moderate, significant correlation between IC and all three subscales as well as total BIS-11 score.
Nagoshi	99	Undergrads, alcohol users	ICS, Part 3	Eysenck I.7	Moderate, significant correlation
Patock-Peckham, King, Backer-Fulghum, Morgan-Lopez, & Leeman	11	Undergrads	ICS, Part 3	UPPS	Significant path from negative urgency score to impaired control. No other significant paths in SEM to predict drinking quantity and alcohol-related problems.
Patock-Peckham, King, Morgan-Lopez, Ulloa & Filson-Moses	11	Undergrads	ICS, Part 3	Eysenck I.7	Significant path from impulsivity to impaired control among both men and women in a multiple group SEM model to predict alcohol-related problems.
Patock-Peckham & Morgan-Lopez	06	Undergrads, alcohol users	ICS, Part 3	Eysenck I.7	Significant path from impulsiveness to impaired control in SEM model to predict alcohol frequency/quantity of use and alcohol-related problems

Note. All studies were cross-sectional. Moderate correlation (0.30–0.49). Yr = year, IC = impaired control, Eysenck I.7 = impulsiveness subscale of the Eysenck Personality Questionnaire, version 7 (Eysenck, Pearson, Eastin, & Allsopp, 1985), ICS = Impaired Control Scale, BIS-11 = Barratt Impulsiveness Scale, version 11 (Patton, Stanford, & Barratt, 1995), UPPS = UPPS Impulsive Behavior Scale, original version (Whiteside & Lynam, 2001), SEM = structural equation model. Part 2 of the ICS assesses past difficulties limiting alcohol use. Part 3 of the ICS measures beliefs about future difficulties