Relationships of Impulsivity and Subjective Response to Alcohol Use and Related Problems

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ABSTRACT. Objective: Impulsivity and subjective response to alcohol are predictors of alcohol use disorder. The purpose of this study was to replicate and extend prior research examining relationships between impulsivity and subjective response patterns. In addition, impulsivity and initial subjective response patterns were examined in relation to current heavy episodic drinking and alcohol-related problems. **Method:** Data were cross-sectional, retrospective self-reports, obtained from baseline assessments from five studies affiliated with the Yale Center for the Translational Neuroscience of Alcoholism. Analyses were conducted in a sample restricted to nondependent, young adults (n = 186) and in a larger, more heterogeneous sample (n = 363). Data were analyzed using hierarchical regression in three separate types of models. **Results:** In the young adult, nondependent sample, impulsivity was a statistically significant predictor of lower recent sedative subjective response. Impulsivity and initial sedative subjective response patterns were statistically significant predictors of past-year heavy drinking. Impulsivity, but not initial subjective response patterns, was a statistically significant predictor of past-year alcohol-related problems. Findings in the larger sample were similar. **Conclusions:** More-impulsive individuals may perceive less sedation from alcohol, which is associated with increased heavy drinking. However, higher levels of impulsivity may be more responsible than diminished subjective response for poor decision making that results in negative drinking consequences. These results suggest that high impulsivity and certain subjective response patterns are worthy intervention targets. (*J. Stud. Alcohol Drugs, 78,* 835–843, 2017)

ALCOHOL USE DISORDER (AUD) remains a prevalent mental disorder in the United States. The recent National Epidemiologic Survey on Alcohol and Related Conditions–III (NESARC-III) found that past-year and lifetime rates of AUD were 13.9% and 29.1%, respectively (Grant et al., 2015). To better understand risky alcohol use and AUD, and to inform public health efforts, it is important to recognize relevant risk factors associated with heavy drinking and related problems.

One known risk factor for AUD is subjective response (e.g., King et al., 2002; Newlin & Thomson, 1990; Schuckit, 1994), which "reflects individual differences in sensitivity to the pharmacological effects of alcohol" (Morean & Corbin, 2010, p. 386). Two prevailing theories have been proposed to explain relations between subjective response and problem alcohol use. Initially, the Low Level of Response (LLR) model (Schuckit, 1994) posited that the ability to consume large quantities of alcohol while experiencing dampened subjective effects (Schuckit, 1999) was a risk factor for future AUD. Accordingly, drinkers with weakened subjective effects received less indication to slow down or stop drinking. As a result, drinking increased, leading to greater risk for developing AUD (see Morean & Corbin, 2010, for a review). Increased drinking because of this faulty feedback system may lead to increased tolerance, which can also create a perceived need for increased levels of consumption to experience desired effects of intoxication (Schuckit, 1994).

Measures typically used to assess subjective response under the LLR model capture primarily aversive, sedative effects of alcohol (Morean & Corbin, 2010; Quinn & Fromme, 2011). To account for both stimulant and sedative responses to alcohol, Newlin and Thomson's (1990) Differentiator Model suggests that those who experience greater sensitivity to excitatory, pleasurable effects of alcohol and less sensitivity to aversive effects of alcohol may have greater motivation to drink. Recent research by King et al. (2014) found relationships between the Differentiator Model and a greater number of AUD symptoms through 6 years of follow-up.

Alcohol administration study findings have clinical relevance, but measuring subjective response to actual alcohol intake is often difficult (e.g., administering alcohol to underage individuals is typically not possible, although there have been exceptions [e.g., Behar et al., 1983; Schuckit et al., 1994]). Moreover, alcohol administration is costly and time consuming. Thus, the Self-Rating of the Effects of Alcohol (SRE; Schuckit et al., 1997a) was created to measure retrospective self-reports of the perceived effects of alcohol at three distinct time frames: the individual's first five experiences with alcohol, the heaviest period of alcohol use in the respondent's lifetime, and the most recent 3 months of drinking at least once a month. By assessing drinkers' first five experiences with alcohol, researchers seek to ascertain whether an inherently low response to alcohol existed before onset of tolerance and problem drinking. Although the

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SRE pertains primarily to the sedating effects of alcohol, single-item measures of a subjective "high" have been used to assess stimulant-like effects in prior alcohol administration studies and have shown to be significantly correlated with other measures of stimulant response (Corbin et al., 2008).

Evidence linking subjective response to AUD has prompted a search for factors contributing to higher-risk patterns of subjective response. To date, family history of alcohol problems has been the most commonly addressed factor (e.g., Knopik et al., 2004). LLR has been found to have a genetic component (Schuckit, 1999) and when studied longitudinally, a relationship was found between LLR to alcohol at age 20 and a fourfold greater likelihood of alcoholism 10 years later (Schuckit, 1994). In addition, heavy drinking has been studied frequently for its relationship to high-risk subjective response profiles (Quinn & Fromme, 2011). Heightened response to the positive, stimulating effects of alcohol has been supported empirically as a precipitant to future drinking and maintenance of heavy drinking (King et al., 2011, 2014, 2016).

Impulsivity is another construct related to AUD risk and potentially to subjective response. Impulsivity is broadly defined as a tendency to react rapidly or in unplanned ways to internal or external stimuli, with suboptimal regard for future consequences (Brewer & Potenza, 2008; Moeller et al., 2001). Several studies have shown a relationship between impulsivity and alcohol use (Dick et al., 2010; Soloff et al., 2000), alcohol-related problems (Magid et al., 2007), and alcohol dependence (Rubio et al., 2008; Verdejo-Garcia et al., 2008). Further, studies have concluded that impulsivity and alcohol/substance use disorders share common genetic links (Kendler et al., 2003; Krueger et al., 2002; Young et al., 2000). Reciprocal relationships between impulsivity and alcohol use have also been found (Reed et al., 2012).

Although impulsivity's links to alcohol are well established, less is known about how and why impulsivity increases problem-drinking risk (Dalley et al., 2011). Subjective response is a possible mechanism linking impulsivity to problem drinking. Impulsive individuals typically gravitate toward rewarding experiences and have a diminished ability to inhibit their behaviors under demanding circumstances (Patterson & Newman, 1993). Thus, exploring the extent to which impulsive individuals have parallel experiences when they drink (i.e., elevated rewarding stimulant and dampened aversive sedating responses) is warranted.

Despite this theoretical relationship between impulsivity and subjective response, minimal research has linked these two constructs as risk factors for AUD. Based on the acquired preparedness model (APM), Anderson et al. (2003) proposed relationships among impulsivity, alcohol use, and alcohol expectancies, which, like subjective response, pertain to drinkers' experience of different effects of alcohol. The APM posits that more-impulsive individuals tend to learn more of the positive, rewarding aspects of their social environment and less about the negative, aversive aspects, thus a link between impulsivity and positive alcohol expectancies, which in turn leads to problem drinking risk. Using cross-sectional data, Anderson et al. found that alcohol expectancies mediated a relationship between impulsivity and alcohol use. Subsequently, Corbin et al. (2011) replicated and extended findings supporting the APM using prospective data.

Although both subjective response and expectancies pertain to drinkers' experience of alcohol's effects, higher-risk patterns of subjective response are believed to be inherent vulnerabilities, related more directly to alcohol's pharmacologic effects with a strong genetic component (Morean & Corbin, 2010). Although there may be a genetic component to alcohol expectancies (Young-Wolff et al., 2015), these expectancies are posited to be formed largely through experience (Jones et al., 2001). Thus, subjective response and expectancies are related yet distinct constructs (Morean et al., 2015), and research examining relationships between impulsivity and subjective response specifically is warranted. Initial attempts to relate impulsivity to subjective response have yielded equivocal results (e.g., Shannon et al., 2011). However, Leeman et al. (2014) showed that more-impulsive social drinkers tended to report elevated positive, stimulating effects and dampened aversive, sedating effects in an IV alcohol administration paradigm, particularly at higher alcohol doses.

To examine further the relationship between impulsivity and subjective response, the main objective of this study was to replicate and extend previous results found by Leeman et al. (2014) using cross-sectional, retrospective self-report data. We conducted analyses both among nondependent, light to moderate drinking young adults as in the Leeman et al. study and in a larger sample including these younger, nondependent participants along with older participants and heavier drinkers to determine the extent to which the findings would apply among a more heterogeneous sample. Similar to Leeman and colleagues (2014), we hypothesized that more-impulsive individuals will report heightened stimulating and dampened sedating effects during their recent experiences with alcohol. Given our efforts to replicate and extend findings from alcohol administration research in which participants report on their current state, we focused on recent subjective response in these models. Further, we hypothesized that greater self-reported impulsivity and heightened stimulant and dampened sedative subjective response patterns would predict statistically unique variance in frequency of heavy drinking and alcohol-related problems. Given our interest in testing relationships involving inherent subjective response patterns in these models while minimizing effects of heavy drinking on subjective response, we used versions of these variables capturing initial rather than recent subjective response.

Method

Participants

Data for this study were collected as part of a baseline assessment battery in studies affiliated with the Yale Center for the Translational Neuroscience of Alcoholism (CTNA) (see Corbin et al., 2015, for a brief description of individual studies in the CTNA), which recruited both social and higher-risk drinkers. Accordingly, participants had not yet begun study procedures (e.g., medication, alcohol administration) when they completed these measures. These data were collected from 2006 to 2011. Although Corbin et al. (2015) and another study using combined baseline data from CTNA studies (Morean et al., 2014) included self-reported impulsivity, neither prior study involved subjective response.

The present study intended to replicate and extend results reported by Leeman et al. (2014), which was a secondary analysis of data originally reported in Kerfoot et al. (2013). Thus, our goal was to derive from the larger CTNA baseline data a sample that was similar to the nondependent light to moderate drinking sample enrolled by Kerfoot et al. Accordingly, alcohol-dependent individuals were excluded from these analyses. Specifically, we included only participants with scores below 20 on the Short Inventory of Problems (SIP; Miller et al., 1995), which is an approximate cutoff point for alcohol dependence based on the scale item anchor. Based on the upper drinking level of the sample in Kerfoot et al., we included only participants consuming 11 drinks or fewer per drinking day and past-year drinking that averaged less than 90 drinks per month. The result was a sample that reported any past-year drinking, infrequent heavy drinking, and low rates of alcohol-related problems, on average. We also conducted a version of these analyses using a more heterogeneous sample that also included older adults with any past-year drinking and heavier drinkers. Results from both samples are included in this article.

Measures

Demographic variables included years of education, smoking status, and sex.

Impulsivity. Impulsivity was assessed using the Barratt Impulsiveness Scale (BIS-11; Patton et al., 1995). This established, 30-item measure contained questions about impulsive behavior (i.e., "I do things without thinking"). This measure was scored on a four-point scale ranging from *rarely/never* to *almost always/always.* Higher scores indicate higher levels of impulsivity. For continuity with Leeman et al. (2014) and because recent research has called into question the psychometric quality of the BIS-11 subscales (Morean et al., 2014), we used only the total score in the present study, which had good internal consistency reliability ($\alpha = .85$).

Subjective response to alcohol. This measure is an adapted version of the SRE (Schuckit et al., 1997a) that retrospectively assesses the number of alcoholic drinks needed to experience different subjective effects of alcohol. In the original measure, participants were asked four questions regarding how many drinks it took for them to (a) begin to feel different (where you could feel an effect); (b) feel a bit dizzy, or to begin to slur speech; (c) begin stumbling, or walking in an uncoordinated manner; and (d) pass out, or fall asleep when you did not want to. Therefore, higher scores on these items indicate lower levels of subjective response (i.e., SRE). An additional item was added to retrospectively assess the number of drinks it took to feel a subjective "high" (i.e., Single-Item High Measure). Similar single-item measures have been used previously in alcohol administration research (e.g., Bujarski et al., 2015; Corbin et al., 2008). Lower scores on this single-item measure would be indicative of heighted sensitivity to alcohol-induced subjective "high." However, it is possible respondents did not experience the subjective effects listed within this measure, and as such, may have left those questions unanswered. Thus, a variable consisting of the number of valid answers was created to account for the possibility that missing data on this measure may have been indicative of lower-risk drinking (e.g., Morean & Corbin, 2008). For the purposes of this study, only the first five times drinking and most recent period of drinking at least once a month for 3 consecutive months were analyzed.

Alcohol consumption. These items developed and recommended by the National Institute on Alcohol Abuse and Alcoholism (2004) assess participants' frequency and quantity of alcohol use in their lifetime and in the past 12 months. Items selected for the present study examined frequency of drinking overall and frequency of heavy drinking episodes (five drinks for males and four drinks for females within a 2-hour period) in the past year. Both questions are rated on 10-point scales with options ranging from *none* to *every day.* Only participants reporting past-year drinking were included; thus, the least frequent response option for overall frequency in the present study was *1 or 2 times in the past year.*

Alcohol-related problems. The SIP (Miller et al., 1995) assesses alcohol-related problems in five domains (social, interpersonal, intrapersonal, physical, and impulsive behavior). This 15-item questionnaire is scored on a four point (0–3) scale ranging from *never* to *daily/almost daily* (e.g., "I have been unhappy because of my drinking"), with higher scores indicating more alcohol-related problems ($\alpha = .96$).

Data analytic plan

Hierarchical regression models were tested using IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp., Armonk, NY). Three sets of models were tested. The first aimed to predict self-reports of subjective response to alcohol during the most recent 3 months of regular drinking

TABLE 1. Demographic, alcohol, impulsivity, alcohol-related problems, and subjective response characteristics of adult drinkers

Variable	Young adult nondependent sample (n = 186)	Larger sample (n = 363)
Age, in years, *M* (*SD*), range	24.45 (2.64), 21–30	31 (10.65), 19–63
Education, in years, *M* (*SD*), range	16.01 (1.89), 12–21	15.12 (2.19), 12–21
White, %	77.7	75.4
Female, %	54	41.6
Drinking frequency in the past year[a]	6.35 (1.77), 1–10	7.45 (1.97), 2–10
Drinks per drinking day in the past year[b]	3.57 (1.05), 1–7	4.62 (1.94), 2–11
Heavy episodic drinking frequency in the past year[c]	2.44 (1.99), 0–10	4.13 (3.06), 0–10
BIS-11: Total score[d]	61.18 (9.47), 36–87	62.55 (10.61), 33–89
SIP: Total score[e]	3.36 (3.83), 0–19	8.42 (9.81), 0–45
SRE–First 5 Times	3.97 (2.36), 1–25	4.43 (2.69), 1–25
Single-Item High Measure–First 5 Times	2.95 (1.62), 1–11	3.13 (1.93), 1–12
SRE–Recent 3 Months	4.94 (2.78), 1–20	6.79 (4.44), 1–30
Single-Item High Measure–Recent 3 Months	3.81 (2.01), 0.9–15	5.09 (3.37), 0.9–24

Notes: BIS = Barratt Impulsiveness Scale; SIP = Short Inventory of Problems; SRE = Self-Rating of the Effects of Alcohol. [a]Drinking frequency mean score equivalent to 1–2 times a week (young adult, nondependent sample), 2–4 times a week (larger sample); [b]drinks per drinking day mean score equivalent to slightly more than 3–4 drinks per drinking day (young adult, nondependent sample), slightly more than 5–6 drinks per drinking day (larger sample); [c]heavy episodic drinking frequency mean score equivalent to slightly more than 1–2 within the past year (age-restricted sample), slightly more than once a month within the past year (full sample); [d]full range of BIS-11 is 30–120; [e]full range of SIP is 0–45.

(Single-Item High Measure and SRE) with hierarchical entry of three variable groupings (demographics, impulsivity total score, and past-year drinking frequency). Past-year drinking frequency was included to reflect participants' current drinking patterns. Models predicting reports of recent subjective response were tested to draw parallels with alcohol administration studies (e.g., Leeman et al., 2014) in which scores on measures capturing current subjective response were often tested as dependent variables.

The second set of analyses aimed to predict heavy drinking frequency using hierarchical entry of three variable groupings (demographics, impulsivity total score, and subjective response to alcohol [Single-Item High Measure–First 5 Times and SRE–First 5 Times]). These variables (Single-Item High Measure and SRE) were included in separate models because they were highly correlated. The "First 5" versions of the subjective response variables were used in these models because they were designed to capture initial subjective response, thus minimizing effects of heavy alcohol consumption. Further, the First 5 versions refer to effects experienced initially, before current drinking, thus making them appropriate predictor variables.

A third set of models aimed to predict past-year alcohol-related problems using hierarchical entry of four variable groupings (demographics, impulsivity total score, subjective response to alcohol [Single-Item High Measure–First 5 Times and SRE–First 5 Times], and past-year drinking frequency). The strategy for hierarchical entry of variables was to predict each outcome above and beyond demographic variables and to test impulsivity and subjective response as unique predictor variables. Age and race variables were ultimately omitted for parsimony; however, the sex and level of education variables were retained in all models. Because multiple models were tested, α was set at .01.

Preliminary models were tested that included a cigarette smoker status variable, interactions by sex, and a variable capturing the number of valid responses on the SRE. Although the cigarette smoker status variable was a significant predictor in multiple models, smoking status did not influence results involving impulsivity and subjective response variables, which were the main variables of interest. Further, the smoker status variable had a considerable amount of missing data. Similar to smoker status, the number of valid responses variable was also a significant predictor in several models but did not affect results involving impulsivity or the SRE; thus, the number of valid responses and smoker status were dropped for parsimony. All predictor variables were tested for interactions with sex. However, none of these interactions was statistically significant; thus, they were excluded in the final versions of the models reported here.

Results

Sample demographics

Descriptive data for both the young adult, nondependent (n = 186) and the larger, more heterogeneous sample (n = 363) are reported in Table 1. Drinking frequency means

Table 2. Bivariate correlations among study variables (young adult, nondependent sample above diagonal; larger sample below diagonal)

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. Age		.115	.318*	-.139	-.082	-.004	-.127	.058	-.11	.001	-.205*
2. Sex	.076		-.118	.085	.102	.109	.135	.321*	.388*	.31*	.324*
3. Education	-.125*	-.166*		-.206*	-.069	-.02	-.177*	-.093	-.202*	-.147	-.245*
4. Impulsivity	-.097	.127	-.221*		.309*	.266*	.307*	.068	.274*	.034	.134
5. Alcohol Problems	.253*	.196*	-.304*	.333*		.441*	.584*	.127	.372*	.037	.258*
6. Drinking frequency	.253*	.258*	-.277*	.288*	.507*		.425*	.135	.353*	.033	.231*
7. HED frequency	.114	.23*	-.331*	.358*	.626*	.595*		.288*	.576*	.177	.412*
8. SRE–First 5 Times	-.004	.327*	-.147*	.061	.158*	.276*	.205*		.718*	.777*	.557*
9. SRE–Recent 3 Months	.027	.382*	-.26*	.32*	.425*	.519*	.543*	.687*		.518*	.788*
10. High Measure–First 5 Times[a]	-.06	.267*	-.139*	.018	.102	.171*	.135*	.808*	.536*		.655*
11. High Measure–Recent 3 Months[b]	.034	.324*	-.28*	.208*	.355*	.414*	.418*	.622*	.848*	.665*	

[a]Single-Item High Measure–First 5 Times; [b]Single-Item High Measure–Recent 3 Months.
*Correlation is significant at the .01 level (two tailed).

were equivalent to 1–2 times per week in the young adult, nondependent sample, with an average between 1 and 2 heavy drinking episodes within the past year. This sample resembled that of Leeman et al. (2014) in terms of severity of drinking and demographics. The larger sample reported drinking on average 2–4 times per week, with an average of slightly more than monthly heavy episodic drinking.

To normalize skewed data, continuous predictor variables were transformed. Past-year drinking frequency was negatively skewed, so this variable was squared, which brought skew close to acceptable levels. The Subjective High–First 5 Times variable was positively skewed, so this variable was log transformed. The SRE–First 5 Times variable was highly skewed due in part to outliers, which were Winsorized down to a value equal to the mean plus three standard deviations (Tukey, 1977). Given that positive skew remained, the variable was then log transformed to reduce skew to an acceptable level. Table 2 provides bivariate correlations among study variables.

Models predicting subjective response

Impulsivity was a statistically significant predictor of only the SRE–Recent 3 Months in both samples. In the young adult, nondependent sample, impulsivity went from being statistically significant in the first entry to a trend level predictor ($p = .029$) with the addition of past-year drinking frequency in the final model. In the larger sample, impulsivity remained a statistically significant predictor after the addition of past-year drinking frequency in the final model. However, impulsivity did not statistically predict the Single-Item High Measure in either sample (Table 3, Table 4).

Models predicting past-year heavy drinking frequency

Beyond demographics, impulsivity was a statistically significant predictor of past-year heavy drinking at first entry and in final models within both samples. Similarly, the SRE–First 5 Times variable was a statistically significant predictor of past-year heavy drinking frequency in the final model in both samples. Subjective high (i.e., "Single-Item High Measure") did not predict heavy drinking frequency in either sample (Table 5, Table 6).

Models predicting past-year alcohol-related problems

At first entry and in the final model, impulsivity related significantly to past-year alcohol-related problems (Table 7, Table 8). Neither subjective response variable was a statistically significant predictor of past-year alcohol-related problems in any model. Past-year drinking frequency was a statistically significant predictor of past-year alcohol-related problems in both samples.

Discussion

Given the high prevalence of AUD, understanding pathways leading to problematic alcohol consumption has clinical and theoretical importance. Although impulsivity is an established predictor of alcohol-related problems (Lejuez et al., 2010), less is known about how impulsivity confers problem drinking risk. Our data suggest that certain subjective response patterns may help to explain this relationship. Similar to the results of Leeman et al. (2014), more-impulsive individuals reported needing more alcohol to experience sedative effects from alcohol during recent alcohol use. However, unlike Leeman et al. (2014), impulsivity did not predict heightened stimulant effects during recent alcohol use, perhaps because of the use of a single retrospective item in the present study. In addition, impulsivity and initial dampened negative, sedative subjective response patterns were associated with past-year heavy drinking frequency, whereas impulsivity but not subjective response was associated with past-year alcohol-related problems. These findings suggest relations between impulsivity, dampened subjective response patterns, and heavy drinking frequency, such that more-impulsive individuals may have a weaker "stop signal" to slow down drinking, possibly leading to more frequent

TABLE 3. Hierarchical regressions predicting Single-Item High Measure and SRE–Recent 3 Months in young adult, nondependent sample

		Single-Item High Measure–Recent 3 Months								SRE–Recent 3 Months							
		First entry into model				Final model				First entry into model				Final model			
Step	Predictor	*B*	*SE B*	β	*p*	*B*	*SE B*	β	*p*	*B*	*SE B*	β	*p*	*B*	*SE B*	β	*p*
Step 1	Sex[a]	1.242	0.28	.308	.000	1.141	0.28	.283	.000	2.168	0.371	.391	.000	1.964	0.354	.354	.000
	Education	-0.254	0.076	-.234	.001	-0.238	0.076	-.218	.002	-0.237	0.101	-.157	.02	-0.178	0.097	-.118	.068
Step 2	Impulsivity	0.015	0.015	.069	.326	0.005	0.016	.025	.734	0.064	0.019	.219	.001	0.043	0.02	.149	.029
Step 3	Past-year drinking frequency	–	–	–	–	0.196	0.089	.16	.028	–	–	–	–	0.399	0.116	.229	.001

Notes: Single-Item High Measure–Recent 3 Months: Step 1, R^2 = .162; Step 2, R^2 = .167; Step 3, R^2 = .189. SRE–Recent 3 Months: Step 1, R^2 = .191; Step 2, R^2 = .237; Step 3, R^2 = .284. *B* = unstandardized coefficient; *SE B* = standard error of unstandardized coefficient; β = standardized coefficient. [a]Sex: 1 = *male,* 0 = *female.*

TABLE 4. Hierarchical regressions predicting Single-Item High Measure and SRE–Recent 3 Months in larger sample

		Single-Item High Measure–Recent 3 Months								SRE–Recent 3 Months							
		First entry into model				Final model				First entry into model				Final model			
Step	Predictor	*B*	*SE B*	β	*p*	*B*	*SE B*	β	*p*	*B*	*SE B*	β	*p*	*B*	*SE B*	β	*p*
Step 1	Sex[a]	1.95	0.331	.291	.000	1.471	0.321	.219	.000	3.22	0.417	.366	.000	2.353	0.375	.267	.000
	Education	-0.404	0.076	-.261	.000	-0.265	0.076	-.171	.001	-0.436	0.096	-.216	.000	-0.19	0.088	-.094	.031
Step 2	Impulsivity	0.038	0.016	.118	.019	0.016	0.016	.049	.32	0.098	0.02	.237	.000	0.057	0.018	.137	.002
Step 3	Past-year drinking frequency	–	–	–	–	0.539	0.088	.311	.000	–	–	–	–	0.908	0.102	.401	.000

Notes: Single-Item High Measure–Recent 3 Months: Step 1, R^2 = .173; Step 2, R^2 = .186; Step 3, R^2 = .266. SRE–Recent 3 Months: Step 1, R^2 = .203; Step 2, R^2 = .255; Step 3, R^2 = .389. *B* = unstandardized coefficient; *SE B* = standard error of unstandardized coefficient; β = standardized coefficient. [a]Sex: 1 = *male,* 0 = *female.*

TABLE 5. Hierarchical regressions predicting past-year heavy drinking frequency using the Single-Item High Measure and SRE–First 5 Times in young adult, nondependent sample

		Predicting heavy drinking frequency using Single-Item High Measure								Predicting heavy drinking frequency using SRE							
		First entry into model				Final model				First entry into model				Final model			
Step	Predictor	*B*	*SE B*	β	*p*	*B*	*SE B*	β	*p*	*B*	*SE B*	β	*p*	*B*	*SE B*	β	*p*
Step 1	Sex[a]	0.498	0.273	.133	.07	0.235	0.278	.063	.398	0.498	0.273	.133	.07	-0.005	0.269	-.001	.986
	Education	-0.179	0.073	-.177	.016	-0.098	0.073	-.097	.183	-0.179	0.073	-.177	.016	-0.093	0.069	-.092	.182
Step 2	Impulsivity	0.05	0.014	.247	.001	0.05	0.014	.247	.001	0.05	0.014	.247	.001	0.046	0.014	.229	.001
Step 3	High measure[b]	–	–	–	–	2.071	0.895	.174	.022	–	–	–	–	–	–	–	–
	SRE[c]	–	–	–	–	–	–	–	–	–	–	–	–	4.05	0.868	.337	.000

Notes: Single-Item High Measure: Step 1, R^2 = .053; Step 2, R^2 = .111; Step 3, R^2 = .137. SRE: Step 1, R^2 = .053; Step 2, R^2 = .111; Step 3, R^2 = .208. *B* = unstandardized coefficient; *SE B* = standard error of unstandardized coefficient; β = standardized coefficient. [a]Sex: 1 = *male,* 0 = *female;* [b]Single-Item High Measure–First 5 Times; [c]SRE–First 5 Times.

heavy drinking. Retrospectively recalled subjective response to alcohol, however, did not show a direct relationship with alcohol-related problems. Instead, more-impulsive individuals, who tend to drink more, may also make decisions with suboptimal regard for future consequences from drinking. These results, however, should be interpreted with caution given the cross-sectional and non-experimental nature of the study design.

Although there are no gold standard substitutes for alcohol administration studies in determining subjective response, using the SRE is a viable alternative. Specifically, one advantage of the SRE is the ability to assess retrospectively the amount of alcohol required to feel subjective effects during initial experiences drinking alcohol, before onset of tolerance. Prior studies have shown the SRE accurately reflects subjective responses to alcohol retrospectively (Schuckit et al., 1997a). Consistent with the literature (Schuckit et al., 1997a), self-reported experience of less negative, sedating effects from alcohol during initial alcohol consumption significantly predicted past-year heavy drinking. Reports of heightened, stimulating effects from alcohol assessed with the Single-Item High Measure did not clearly predict problem drinking.

Relationships between dampened sedative response and heavy drinking in the present study would have been predicted by the LLR model (Schuckit, 1994, 1999; Schuckit et al., 1997a) and the Differentiator Model (Newlin & Thomson, 1990). However, the Differentiator Model would have also

Table 6. Hierarchical regressions predicting past-year heavy drinking frequency in larger sample using the Single-Item High Measure and SRE-First 5 Times

		Predicting heavy drinking frequency using Single-Item High Measure								Predicting heavy drinking frequency using SRE							
		First entry into model				Final model				First entry into model				Final model			
Step	Predictor	*B*	*SE B*	β	*p*	*B*	*SE B*	β	*p*	*B*	*SE B*	β	*p*	*B*	*SE B*	β	*p*
Step 1	Sex[a]	1.047	0.298	.174	.001	0.798	0.299	.132	.008	1.047	0.298	.174	.001	0.472	0.305	.078	.122
	Education	-0.406	0.068	-.295	.000	-0.319	0.067	-.232	.000	-0.406	0.068	-.295	.000	-0.302	0.066	-.22	.000
Step 2	Impulsivity	0.078	0.014	.278	.000	0.078	0.014	.276	.000	0.078	0.014	.278	.000	0.073	0.014	.259	.000
Step 3	High measure[b]	–	–	–	–	1.025	0.852	.06	.23	–	–	–	–	–	–	–	–
	SRE[c]	–	–	–	–	–	–	–	–	–	–	–	–	3.33	.895	.19	.000

Notes: Single-Item High Measure: Step 1, $R^2 = .129$; Step 2, $R^2 = .202$; Step 3, $R^2 = .205$. SRE: Step 1, $R^2 = .129$; Step 2, $R^2 = .202$; Step 3, $R^2 = .231$. *B* = unstandardized coefficient; *SE B* = standard error of unstandardized coefficient; β = standardized coefficient. [a]Sex: 1 = *male,* 0 = *female;* [b]Single-Item High Measure–First 5 Times; [c]SRE–First 5 Times.

Table 7. Hierarchical regressions predicting past-year alcohol-related problems using the Single-Item High Measure and SRE–First 5 Times in young adult, nondependent sample

		Predicting alcohol-related problems using Single-Item High Measure								Predicting alcohol-related problems using SRE							
		First entry into model				Final model				First entry into model				Final model			
Step	Predictor	*B*	*SE B*	β	*p*	*B*	*SE B*	β	*p*	*B*	*SE B*	β	*p*	*B*	*SE B*	β	*p*
Step 1	Sex[a]	0.806	0.532	.112	.131	0.282	0.511	.039	.582	0.806	0.532	.112	.131	0.227	0.516	.032	.661
Step 2	Impulsivity	0.105	0.027	.272	.000	0.072	0.026	.187	.007	0.105	0.027	.272	.000	0.071	0.026	.184	.008
Step 3	High measure[b]	0.885	1.735	.039	.611	0.756	1.615	.033	.64	–	–	–	–	–	–	–	–
	SRE[c]	–	–	–	–	–	–	–	–	1.643	1.770	.071	.355	1.199	1.651	.052	.469
Step 4	Past-year drinking frequency	–	–	–	–	0.763	0.143	.368	.000	–	–	–	–	0.759	0.143	.366	.000

Notes: Single-Item High Measure: Step 1, $R^2 = .013$; Step 2, $R^2 = .086$; Step 3, $R^2 = .087$; Step 4, $R^2 = .214$. SRE: Step 1, $R^2 = .013$; Step 2, $R^2 = .086$; Step 3, $R^2 = .09$; Step 4, $R^2 = .215$. *B* = unstandardized coefficient; *SE B* = standard error of unstandardized coefficient; β = standardized coefficient. [a]Sex: 1 = *male,* 0 = *female;* [b]Single-Item High Measure–First 5 Times; [c]SRE–First 5 Times.

Table 8. Hierarchical regressions predicting past-year alcohol-related problems in larger sample using the Single-Item High Measure and SRE–First 5 Times

		Predicting alcohol-related problems using Single-Item High Measure								Predicting alcohol-related problems using SRE							
		First entry into model				Final model				First entry into model				Final model			
Step	Predictor	*B*	*SE B*	β	*p*	*B*	*SE B*	β	*p*	*B*	*SE B*	β	*p*	*B*	*SE B*	β	*p*
Step 1	Age	0.232	0.042	.272	.000	0.192	0.039	.225	.000	0.232	0.042	.272	.000	0.196	0.038	.23	.000
	Sex[a]	2.416	0.896	.132	.007	0.599	0.845	.033	.479	2.416	0.896	.132	.007	0.304	0.865	.017	.726
	Education	-1.017	0.206	-.242	.000	-0.507	0.189	-.121	.008	-1.017	0.206	-.242	.000	-0.497	1.89	-.118	.009
Step 2	Impulsivity	0.267	0.042	.306	.000	0.189	0.04	.217	.000	0.267	0.042	.306	.000	0.187	0.04	.214	.000
Step 3	High measure[b]	2.27	2.609	.043	.385	0.164	2.449	.003	.947	–	–	–	–	–	–	–	–
	SRE[c]	–	–	–	–	–	–	–	–	6.504	2.699	.122	.016	2.701	2.587	.05	.297
Step 4	Past-year drinking frequency	–	–	–	–	1.63	.222	.355	.000		–	–	–	1.582	0.225	.345	.000

Notes: Single-Item High Measure: Step 1, $R^2 = .171$; Step 2, $R^2 = .258$; Step 3, $R^2 = .26$; Step, 4 $R^2 = .358$. SRE: Step 1, $R^2 = .171$; Step 2, $R^2 = .258$; Step 3, $R^2 = .27$; Step 4, $R^2 = .36$. *B* = unstandardized coefficient; *SE B* = standard error of unstandardized coefficient; β = standardized coefficient. [a]Sex: 1 = *male,* 0 = *female;* [b]Single-Item High Measure–First 5 Times; [c]SRE–First 5 Times.

predicted significant relationships involving elevated stimulant response, which we did not find in the present study.

Based on the present findings, impulsivity may be related to low sedative response to alcohol. It appears certain subjective response patterns closely align with the conceptual framework of the APM (Anderson et al., 2003). In the current study, we found that more-impulsive individuals perceived dampened aversive, sedative effects from recent alcohol use and, in a separate model, that these reports of initial dampened sedation related to more frequent heavy drinking. We did not find significant results involving greater experience of positive effects of alcohol as posited in the APM. Alcohol expectancies and subjective response are both related to effects of alcohol, yet have been shown to be distinct constructs (Morean et al., 2015). Although differences exist between the APM and the findings of this study, our results lend support to the conclusion that the sedative effects from alcohol relate to impulsivity and higher-risk patterns of alcohol consumption. Given the cross-sectional nature and a lack of power in the current study, conducting true mediational analyses was not possible. However, future experimental or longitudinal studies can help to better under-

stand the causal nature of relationships among impulsivity, subjective response, and higher-risk alcohol use.

The present study has limitations. Leeman et al. (2014) used a psychometrically tested and valid measure assessing stimulant responses to alcohol, whereas our subjective high measure consisted of one item. This limitation could partially explain nonsignificant results in the present study. Specifically, the Subjective Effects of Alcohol Scale (Morean et al., 2013) could help clarify relations between impulsivity and stimulation further; however, this measure was not available in the present study. Although retrospective self-reports provide information about participant drinking patterns, reports could have been compromised by recall bias. In addition, older individuals or individuals with an extensive drinking history may be less likely to accurately remember how many drinks it took to experience effects from alcohol during their initial drinking experiences. However, participants seem likely to remember generally whether it took large or small quantities of alcohol to produce subjective effects. Further, the SRE has evinced good test–retest reliability (Schuckit et al., 1997b), and numerous studies have used this measure as a proxy in lieu of alcohol administration (e.g., Duranceaux et al., 2008; Tapert et al., 2004). Acknowledging these potential limitations, the SRE remains an important tool in helping to elucidate the potentially detrimental effects of sedative subjective response patterns at the initial onset of drinking (Schuckit et al., 2007).

These results add to our understanding that specific subjective response patterns are associated with both personality constructs and alcohol use. Specifically, more-impulsive individuals may experience less sedation from alcohol, and individuals who experience less sedation may be more prone to heavy drinking. This finding contributes to our understanding of how and why impulsivity relates to problem drinking risk. However, more research is needed to further examine subjective response and other relevant constructs. Future studies should focus on impulsivity and subjective response as related risk factors for AUD while using both retrospective reports of subjective response and reports of subjective response during actual alcohol administration. Further, sufficiently powered longitudinal research (particularly studies initially enrolling participants during childhood or adolescence) should examine whether subjective response acts as an underlying mechanism between impulsivity and drinking outcomes. This study also points to the possibility that interventions to reduce impulsivity (e.g., mindfulness) could be evaluated as a means to reduce risk for AUD and alcohol-related consequences among more-impulsive individuals.

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