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Association of Anticipated and Laboratory-Derived Alcohol Stimulation, Sedation, and Reward

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Abstract

Background—Laboratory alcohol challenges are the “gold standard” for obtaining accurate measurements of subjective alcohol stimulation, sedation, and reward. However, these approaches are time- and resource-intensive. The present study examined the extent to which self-reported anticipated alcohol stimulation, sedation, and reward corresponded with those same responses measured with the Biphase Alcohol Effects Scale (BAES), Brief-BAES (B-BAES), and Drug Effects Questionnaire (DEQ) during a controlled laboratory alcohol challenge.

Methods—Participants were 106 light-to-heavy social drinkers (58.5% male; mean $\pm$ SD age = 35.8 ± 3.2 years) who completed the Anticipated BAES and DEQ, as well as laboratory-derived versions of these scales 30- and 60-minutes after consuming placebo and 0.8 g/kg alcohol on separate days as part of laboratory sessions in the Chicago Social Drinking Project.

Results—Anticipated BAES/B-BAES and anticipated DEQ alcohol effects were strong predictors of their corresponding laboratory-derived responses during both the rising limb and at peak breath alcohol concentrations. Effects were significant even when accounting for age, sex, past month heavy drinking frequency, and laboratory session order (placebo or alcohol first).

Conclusions—The present study provides strong preliminary support for measuring anticipated alcohol effects with the Anticipated BAES/B-BAES and Anticipated DEQ as a proxy of subjective responses experienced during a controlled laboratory alcohol challenge. The findings lend support for these measures as viable alternatives to other anticipatory scales when laboratory-derived alcohol response measurement is not feasible.

Keywords

subjective alcohol response; Biphase Alcohol Effects Scale; Drug Effects Questionnaire; anticipated; alcohol expectancies

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Introduction

Numerous studies have shown that certain acute subjective responses to alcohol may increase risk for alcohol use disorder (AUD). Research in this area has historically focused on lower responses to alcohol as a risk for future AUD (Schuckit, 1994; Schuckit, 2009), particularly with regard to the impairing and sedative effects of alcohol (Newlin and Thomson, 1990; Quinn and Fromme, 2011). However, there has also been increasing evidence for heightened responses to the stimulating and rewarding effects of alcohol as a risk factor for the development of future AUD (King et al., 2011; King et al., 2014; Newlin and Thomson, 1990; Quinn and Fromme, 2011) and maintenance of AUD (King et al., 2016). Notably, lower sedating and higher stimulating effects of alcohol as measured by the Biphasic Alcohol Effect Scale (BAES; Martin et al., 1993) may not be mutually exclusive, as both effects may confer increased risk for future AUD (Pedersen, 2016; Quinn and Fromme, 2011).

Laboratory alcohol challenge paradigms allow for the direct measurement of stimulating and sedating alcohol effects before and after administration of alcohol and/or a placebo beverage. However, these approaches are time-, labor-, and resource-intensive. The total experimental time for data collection may exceed 10 or more hours per participant to allow for the alcohol elimination phase before discharging a participant at breath alcohol concentration (BrAC) 0.04 g/210L or lower (e.g., .02 g/210L), as per NIAAA guidelines (NIAAA, 2005). Experimenters also typically assume the expense of participant transportation to ensure safe travel home after the session. Therefore, while the laboratory alcohol challenge paradigm is the longstanding gold standard for measuring subjective alcohol responses, this approach may not be practical on a large scale. These limitations highlight the need for well-validated self-report measures of alcohol's anticipated or expected subjective effects to facilitate research on the associations among its stimulant, rewarding, and sedative responses and AUD risk.

To circumvent administration of alcohol in the laboratory, several self-report measures have been developed to assess individuals' recall or expectations of their subjective or behavioral responses to alcohol (Brown et al., 1980; Fromme et al., 1993; Morean et al., 2012; O'Neill et al., 2002; Rohsenow, 1983; Schuckit et al., 1997a). According to social learning theory of alcohol use, the experience of subjective effects of alcohol (positive or negative) influences the development of alcohol expectancies, which in turn affect (i.e., increase or decrease) the likelihood of subsequent drinking behavior (Maisto et al., 1999). The most widely used retrospective measure of alcohol effects has been the Self-Rating of the Effects of Alcohol Questionnaire (Schuckit et al., 1997a), a 4-item self-report measure that asks respondents to recount the number of standard drinks they expect it would take them to begin to feel different, feel dizzy or slur speech, stumble or walk in an uncoordinated manner, and pass out or fall asleep. The SRE has good test-retest reliability (Schuckit et al., 1997a) and has been shown to be associated with laboratory-derived subjective alcohol responses in young male drinkers assessed via the Subjective High Assessment Scale (SHAS; Judd et al., 1977) (Schuckit et al., 1997b). However, the SHAS was not developed to assess alcohol effects per se and the utility of the SRE may be hampered as the items mostly assess alcohol's sedating/impairing effects.

Other recently developed scales of anticipated alcohol effects show promise for estimating drinkers' subjective responses outside the laboratory environment. These include the 22-item Anticipated Effects of Alcohol Scale (AEAS; Morean et al., 2012) and the 15-item Alcohol Sensitivity Questionnaire (ASQ; O'Neill et al., 2002). The AEAS has been shown to correlate with laboratory-derived alcohol effects from the shorter 14-item Subjective Effects of Alcohol Scale (SEAS; Morean et al., 2013a) in a sample of 102 young adults consuming a moderate dose of alcohol in a simulated bar setting. While AEAS and SEAS scores were correlated in that study, the AEAS scores were generally of a higher magnitude than those on the SEAS. The ASQ includes anticipated light- and heavy-drinking factors which have been shown recently to be associated with BAES scores and subjective intoxication, and which provided a more accurate prediction of subjective alcohol stimulation and sedation than did the SRE in 219 participants randomized to an alcohol challenge (Fleming et al., 2016). In addition to the aforementioned scales, the 14-item Anticipated Biphasic Alcohol Effects Scale (Anticipated BAES; Earleywine and Martin, 1993) has shown good reliability (Earleywine, 1994b; Earleywine and Martin, 1993) and validity, as evidenced by significant associations between scores on that measure and drinking behavior (Earleywine, 1994b) and family history risk for AUD (Earleywine, 1994a). However, the validity of the Anticipated BAES as a proxy for subjective responses to alcohol in the laboratory has not been examined previously. Also, while the Drug Effects Questionnaire (DEQ; Johanson and Uhlenhuth, 1980; Morean et al., 2013b) is a psychometrically sound measure of alcohol reward, i.e., liking and wanting, previous research has not established an anticipatory version of this scale for use outside the laboratory environment.

Continued development of psychometrically sound instruments to assess the stimulating and rewarding effects of alcohol outside the labor-intensive laboratory challenge paradigm is needed to provide researchers with a range of measures to consider for use outside the laboratory environment. Thus, we sought to add to the literature on anticipated alcohol effects by examining the Anticipated BAES, a short form of that measure based upon the existing Brief-BAES (B-BAES; Rueger et al., 2009), and a newly developed Anticipated DEQ relative to their concomitant measures obtained during a laboratory alcohol challenge. We predicted that the anticipated measures would significantly predict their concomitant laboratory-derived measures, above and beyond session order and other risk factors that may relate to alcohol response such as drinking history, family history of alcohol use disorders, and sex (King et al., 2011; King et al., 2016; King et al., 2014; Quinn and Fromme, 2011; Schuckit, 1984).

Methods

Participants

Data from this study were from the larger ongoing Chicago Social Drinking Project (CSDP) at the University of Chicago (King et al., 2011), which is fully approved by the University of Chicago Institutional Review Board. The sample consisted of $N=106$ participants who were examined during their 10-year follow-up in the study, from January 2015–October 2016. For their initial inclusion in the CSDP, participants had to be generally healthy, non-alcohol dependent young adult drinkers who met criteria for one of two drinking subgroups: heavy

drinker (1–5 heavy drinking episodes per week, 10 drinks weekly) or light drinker (rare heavy drinking, < 6 drinks weekly). Heavy drinking episodes were defined as 5 drinks in an occasion for men or 4 for women, per NIAAA guidelines (Courtney and Polich, 2009; SAMHSA, 2005).

Screening measures included the Alcohol Use Disorder Identification Test (AUDIT; Babor et al., 1989), past six months Alcohol Quantity-Frequency Interview (Cahalan et al., 1969), the Structured Clinical Interview for the DSM-5 (SCID; First et al., 2014), and the Research Diagnostic Criteria two-generational biological family history measure (Andreasen et al., 1977) to assess family history of AUD. Family history positive (FH+; $n = 29$, 39% of the total sample) participants reported 1 primary biological relative or 2 secondary biological relatives with AUD and family history negative (FH–; $n = 23$; 31% of the total sample) participants reported no AUD in biological relatives within the past 2 generations. Twenty-three participants could not provide information sufficient for classification into either the FH+ or FH– groups. For additional details on recruitment and screening, see King et al, 2011; for details on follow-up, see King et al., 2014; 2016.

Procedure

Participants completed measures of anticipated and laboratory-derived alcohol subjective response as part of the larger CSDP, a within-subjects, double-blind, placebo-controlled study. In the laboratory protocol, the participant consumed either an intoxicating alcohol dose equivalent to 4–5 standard alcoholic drinks (0.8 g/kg; 16% volume of ethanol) or an identical placebo beverage (0.0 g/kg; 1% volume of ethanol as taste mask) in random order, with placebo and alcohol sessions separated by at least 24 hours. The beverage contained flavored drink mix, a sucralose-based sugar substitute, water, and the appropriate dose of 190-proof ethanol to consume over a 15-minute interval with the research assistant present. The Alternative Substance Paradigm (Conrad et al., 2012) was employed to reduce alcohol expectancy: the participant was told that the beverage might contain a stimulant, a sedative, alcohol, or a placebo, or two substances in combination and at various dose levels. Participants abstained from alcohol and medications for at least 48 hours prior to the session, as well as caffeine, cigarettes, and food for three hours prior, and consumed a snack upon session arrival at 20% daily calories to reduce the possibility of alcohol-induced nausea.

Subjective response to alcohol was extracted at the rising limb of the BrAC, 30 minutes after initiating drinking with a mean BrAC of $.07 \pm .02$ SD g/210L for the alcohol session, and at peak BrAC, the 60-minute time point with mean BrAC of $.09 \pm .02$ g/210L for the alcohol session. All BrACs for the placebo session were .00 g/210L. These two intervals were chosen because previous work by our group has shown that stimulating and rewarding (liking, wanting) effects predominate in at-risk heavy drinkers during these portions of the BrAC and are associated with higher risk of future AUD and drinking-related problems (King et al., 2011; King et al., 2016; King et al., 2014), and because these time points correspond to Anticipated BAES instructions to rate anticipated alcohol effects immediately after consuming four drinks. The participant was discharged from the session when BrAC was < 0.04 g/210L and s/he showed no objective signs of intoxication based on an observer checklist.

Laboratory measures

The main dependent measures from the laboratory sessions included the 14-item BAES (Martin et al., 1993) and the 100-mm visual analogue scales from the DEQ (Johanson and Uhlenhuth, 1980; Morean et al., 2013b). For both surveys, participants were instructed to “rate the extent to which these words describe your feelings at the present time” (Rueger et al., 2009). The BAES items were presented in alphabetical order with each rated on an 11-point scale from 0 = “not at all” to 10 = “extremely” and summed for two subscales, Stimulation (Stim = elated, energized, excited, stimulated, talkative, up, vigorous) and Sedation (Sed = difficulty concentrating, down, heavy head, inactive, sedated, slow thoughts, sluggish). Subscale scores from the 6-item B-BAES (Rueger et al., 2009) were also computed (B-Stim = energized, excited, up; B-Sed = sedated, slow thoughts, sluggish) to ascertain if B-BAES responses in the laboratory also corresponded to those in the new anticipatory version of the B-BAES (see below). The DEQ items used in the present study were Like (i.e., “do you like the effects you are feeling right now?” anchored from 0 for dislike, and 100 for like very much, with the midpoint neutral) and Want More (i.e., “would you like more of what you consumed right now?” anchored from 0 for not at all to 100 for very much).

Anticipated measures

Participants completed the Anticipated BAES and the Anticipated DEQ following their second laboratory session. As participants were randomized to beverage order, $n = 55$ participants completed the anticipated measures after the alcohol session and $n = 51$ after the placebo session. Beverage order was included in the main analyses as a covariate; see Data Analytic Plan, below. The anticipated versions of the surveys included identical items to their laboratory-derived counterparts but with the instructions modified as “Think about how you would expect to feel immediately after consuming 4 standard alcohol drinks. Please rate the extent to which each item describes how you would feel at that time” (Earleywine and Martin, 1993). The second portion of the Anticipated BAES for a moderate dosage of alcohol pertaining to one’s anticipated effects “1.5 hour after consuming four drinks in 1 hour” was not used as this item was deemed confusing with imposed time intervals that may be confounded by continued drinking for some drinkers but cessation of drinking for others. Therefore, given the inherent challenges in the determination of descending BrAC limb alcohol effects, we rather chose to focus on anticipated alcohol effects earlier in a drinking episode, i.e., corresponding to rising to peak BrAC immediately after consuming four drinks.

Data Analytic Strategy

We used confirmatory factor analysis to verify the 2-factor structure (stimulation, sedation) of the Anticipated BAES and B-BAES in the present study sample, as has been reported previously (Earleywine, 1994b; Rueger et al., 2009). Model fit was assessed using the standardized root mean square residual (SRMR) and the comparative fit index (CFI; Hu and Bentler, 1998). ANOVA and correlation analyses were conducted to compare scores and examine associations among anticipated and laboratory-derived alcohol effects, as well as

among anticipated alcohol effects and past-month drinking behavior to further evaluate the criterion-related and construct validity of the anticipated measures.

For the main analyses, a series of four hierarchical multiple regression analyses were used to test the association of each of the anticipated subjective effects of alcohol (Anticipated BAES/B-BAES and Anticipated DEQ) to their corresponding effects directly measured during the alcohol challenge in the laboratory (BAES/B-BAES and DEQ). Regression analyses were conducted predicting laboratory-derived subjective effects during the rising limb of the BrAC (i.e., 30 minutes after initiation of the beverage), and repeated for peak BrAC measures (60 minutes after the beverage). Sex, family history (dummy coded), and number of heavy drinking episodes in the past month were entered as covariates in the model in step 1. In addition, as participants were randomly assigned to complete the anticipated effect measures after either the placebo or alcohol session (see above), session order was added as a predictor, along with the anticipated measure, in step 2. Finally, anticipated measure x alcohol session interaction terms were included in the models in step 3 to test whether recent exposure (or lack thereof) to alcohol affected associations between anticipated and laboratory-derived outcomes. Regression analyses were repeated with anticipated ratings predicting laboratory-derived ratings during the placebo session to ascertain if anticipatory measures were specific to the pharmacological effects of alcohol. All analyses were conducted in IBM SPSS software (IBM Corporation).

Results

Descriptive analyses characterizing the study sample are presented in Table 1. The sample consisted of 57 light and 49 heavy drinkers from the original classifications in the CSDP. While details of their drinking trajectories are outside the scope of this paper, at the 10-year follow-up, 74% of light drinkers remained with low-risk drinking while 53% of heavy drinkers continued to meet criteria for inclusion in that group. Thus, the sample was heterogeneous with regard to drinking behaviors, from consuming alcohol once a month to daily (Table 1). Means and standard deviations of the anticipated alcohol responses and laboratory-derived subjective responses are shown in Table 2. Anticipated alcohol effects were of a higher magnitude than laboratory-derived subjective effects at both rising and peak BrAC (all ANOVAs significant $p < .05$; see Table 2). Intercorrelations among anticipated and laboratory-derived BAES/B-BAES/DEQ alcohol effect ratings are reported in Table 3. Internal consistencies for the anticipated and laboratory-derived subscale scores were excellent (Cronbach's alphas $.90$).

CFA results with the seven stimulation and seven sedation items of the BAES demonstrated an adequate fit to the data (CFI = .94, SRMR = .10). Results with the three stimulation and three sedation items from the B-BAES demonstrated excellent fit to the data (CFI = .98, SRMR = .04). Further evidence of construct validity of the BAES/B-BAES and DEQ was demonstrated in the pattern of intercorrelations between anticipated and lab-based alcohol effect ratings (see Table 3). All correlations were large in magnitude (Cohen, 1992), and are graphically displayed in Figure 1. Finally, evidence for criterion related validity was demonstrated in the pattern of correlations between anticipatory measures and most drinking -related outcomes (quantity and frequency of alcohol use, number of heavy drinking days,

AUD symptom count, and AUDIT scores). Results showed a pattern of significant correlations between both anticipatory and laboratory-derived alcohol responses and drinking outcomes, with greater stimulating and rewarding effects associated with heavier drinking (drinking quantity, maximum drinks, heavy drinking frequency, AUD symptoms and AUDIT scores) and greater sedative effects inversely associated with these drinking measures (see Table 4). Drinking frequency was the only alcohol consumption measure not consistently associated with alcohol effects which was not surprising as this measure only determines how often alcohol is consumed without regard to amount.

Results from the hierarchical regression analyses predicting laboratory-derived BAES scores (see Table 5) showed that step 1 (R^2 ranged from .07 to .21) and step 2 (R^2 ranged from .19 to .33) were significant, but step 3 (R^2 ranged from .00 to .01) was not significant. In other words, adding the corresponding anticipated effect and session order in step 2 significantly improved the ability of the models to predict the laboratory-derived effect for BAES measures, after accounting for the effects of the covariates. However, adding the interaction term (anticipated measure x alcohol session) in step 3 did not add any predictive power. Thus, there was no evidence that session order affected the association between anticipated and laboratory-based responses, and regression coefficients of the predictors in step 2 were interpreted for all analyses. In all analyses, only the corresponding anticipated effect was significantly related with the laboratory-derived ratings. Of note, past-month heavy drinking frequency was the only covariate significantly associated with laboratory-derived BAES scores in step 1, but this was reduced to non-significance in step 2 with the addition of the anticipated ratings. Repeating the analyses with the B-BAES showed a similar pattern of results (Table 5).

Results using the DEQ were comparable to those with the BAES/B-BAES: the models containing the four covariates entered in step 1 were significantly associated with liking and wanting at the rising BrAC limb and peak BrAC (see Table 5). Adding the anticipated effect and session order in step 2 significantly improved the ability of the models to predict the laboratory-derived effect after accounting for the effects of the covariates, but adding the interaction term in step 3 did not improve predictive power. As with the BAES/B-BAES, the anticipated effect was the only significant predictor in step 2, and past month heavy drinking frequency, which was the only significant covariate in step 1, was reduced to non-significance.

Finally, repeating the analyses above with BAES/B-BAES/DEQ scores from the placebo session as outcomes revealed that the models containing the covariates and corresponding anticipated responses did not predict those outcomes ($F_s < 2.02$, p_s n.s). Thus, anticipated alcohol effects were specifically associated with the pharmacological effects of alcohol.

Discussion

This study was the first to validate measures of anticipated alcohol stimulation, sedation, liking, and wanting against measures of those same effects assessed during a controlled laboratory alcohol challenge. The main finding was that anticipated ratings were strong predictors of laboratory-derived ratings of those effects, even after accounting for sex, family

history of AUD, past month heavy drinking frequency, and order of beverage administration. These results support the validity of anticipated versions of the BAES, B-BAES, and DEQ, and suggest that these measures can provide a good approximation of drinkers' alcohol responses when assessing those same responses via a controlled laboratory alcohol challenge is not feasible.

In light of evidence demonstrating that both laboratory-derived subjective stimulating/rewarding (King et al., 2011; King et al., 2014) and sedating (King et al., 2011; Schuckit, 1984; Schuckit, 1994) responses to alcohol predict later AUD risk and contribute to the maintenance of AUD (King et al., 2016), the present study highlights the utility of the Anticipated BAES/B-BAES and the newly developed Anticipated DEQ for assessing alcohol responses without a laboratory challenge. While directly measured alcohol responses in the laboratory may be preferred in studies examining precise measures across the BrAC, including performance, physiological, subjective, and brain activity, anticipated scales may be a viable option to estimate subjective effects of alcohol in situations where direct measurement is not practical. Such work may include large-scale epidemiological, longitudinal, and prevention/intervention studies. Additional methods to capture alcohol responses will no doubt facilitate new avenues for examining alcohol responses as biomarkers or prognostic indicators of risk for alcohol problems.

The present study results are in line with research by Schuckit and colleagues (Schuckit et al., 1997b) who reported an association between expected and laboratory-derived alcohol sedative-type effects in young adult male drinkers using the SRE and the SHAS, respectively. The results are also consistent with other recent findings showing associations between scores on the AEAS and ASQ and corresponding laboratory-derived alcohol effects (Fleming et al., 2016; Morean et al., 2015). Our study builds upon prior work by including both male and female participants with a range of drinking patterns and showing that anticipated positive-like (i.e., stimulation, liking, wanting) as well as sedative effects of alcohol are strongly associated with these same measures obtained during an alcohol challenge in a well-controlled laboratory setting. To our knowledge, our study is the first to show extensive psychometric support for the Anticipated BAES/B-BAES and our newly introduced Anticipated DEQ. These anticipatory scales may be attractive in that they ascertain the exact same alcohol responses as measured in the laboratory via the BAES/B-BAES and DEQ, in contrast to the SRE, which retrospectively measures primarily sedating alcohol effects, and the ASQ and AEAS, which measure different (but related) anticipated alcohol effects.

Another interesting finding is that anticipated alcohol effects were consistently higher than laboratory-derived alcohol effects during the alcohol challenge. This supports results of a recent study showing greater magnitude of anticipated positive- and negative-valence, high- and low-arousal effects measured via the AEAS versus laboratory-based subjective effects via the SEAS (Morean et al., 2015). We speculate that contextual differences between usual drinking environments and the laboratory setting may be the source of the discrepancy between alcohol measures in these settings. That is, the laboratory environment minimizes the influence of external factors often present during real world drinking episodes, e.g., favorite bar, presence of romantic partners and/or close friends, music, and food, that may

affect perceived subjective responses to alcohol. As the laboratory removes many of these environmental confounds, assessments in that setting may more closely approximate a “pure” (pharmacological) alcohol effect than that estimated by anticipatory measures. Due to the natural discrepancy between anticipated and laboratory-derived subjective alcohol effects, laboratory paradigms may continue to represent the gold standard for ascertaining specific and temporal alcohol responses while minimizing environmental confounds, with anticipatory measures, including the Anticipated BAES/B-BAES and DEQ, providing possible alternatives in larger-scale studies where there are practical limitations to employing alcohol challenge.

There were several strengths in the current study, including a moderately sized and well-characterized sample of drinkers and comparison of anticipated positive- and negative-like alcohol subjective ratings to alcohol responses obtained under controlled laboratory conditions. However, there are also some limitations worth noting. First, this study focused on alcohol effects during rising-to-peak BrAC, when heightened stimulating and rewarding effects have been shown to predict future AUD (King et al., 2011; King et al., 2014), but did not include anticipated effects during the descending BrAC limb (Morean et al., 2015) which may also have relevance to alcohol-related problems (Bujarski et al., 2015; Quinn and Fromme, 2011). Second, the anticipated measures used in this study examined positive-like effects (stimulation and reward) and sedative-like effects (sedation) but not the more positively-valenced sedative effects (calm) or conversely, negatively-valenced stimulant effects (aggression) (Morean et al., 2012). Investigators may need to choose among several valid measures of anticipated alcohol responses, depending on their research question, and the incremental validity of the Anticipated BAES/DEQ above existing measures of anticipated alcohol responses cannot be determined from the present data. Third, while we examined a sample with various drinking patterns and showed associations of anticipated and laboratory-derived alcohol responses across a sample of light to heavy drinkers, for safety reasons all participants needed to have had at least one experience with heavy drinking prior to participating in the larger study. Thus, given that the anticipated versions of the scales ask about participants’ anticipated responses to an intoxicating dose of alcohol, persons who have no prior experience of consuming four or more drinks may not be appropriate for this assessment. Fourth, as participants completed the anticipated measures after their second laboratory session, their recent experience with alcohol (or lack thereof) may have affected their responses. While we did not find evidence of a main effect or interaction of session order with anticipated alcohol responses when predicting laboratory-derived outcomes (Table 5), it is possible that associations between anticipated and laboratory-derived alcohol effects could be influenced by the time since the most recent drinking episode. However, as heavy drinkers consume alcohol frequently, finding an extended period without drinking before administering an anticipated measure may be challenging. Last, the anticipated measures used in this study and other studies require participants to recall their responses to an intoxicating dose of alcohol which could limit their accuracy. Future research could address this limitation by using ecological momentary assessment (EMA) to assess subjective responses to alcohol (Miranda et al., 2014; Piasecki et al., 2012; Ramirez and Miranda, 2014) throughout the course of a real-world drinking episode in relation to the same measures obtained during a laboratory alcohol challenge

(Pedersen, 2016). These future directions may add greatly to the utility of using alternative measures of capturing alcohol responses. Of note, it remains to be seen whether the time frame (days, weeks, months) of anticipated or EMA outcomes measured between and within individuals is associated with subjective alcohol responses measured in the laboratory.

In sum, the results of the present study provide strong preliminary support for measuring anticipated stimulating, sedating, and rewarding effects of alcohol as a proxy of those same responses experienced during a controlled laboratory alcohol challenge. These data suggest that individuals can reasonably estimate their responses to alcohol in the laboratory via anticipated versions of the BAES, B-BAES, and DEQ. Self-reported anticipated alcohol response measures can be a cost- and time-efficient tool to facilitate the next generation of research on the associations among alcohol responses, drinking behavior, and future AUD risk.

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Figure 1. Correlation between laboratory-derived alcohol effects from the BAES and DEQ at peak BrAC (60-minutes post-onset of beverage administration) and the Anticipated BAES and Anticipated DEQ. Figures 1A and 1B represent BAES Stimulation and Sedation, respectively, and Figures 1C and 1D represent DEQ Like and Want More, respectively. All $ps < .0001$. Solid line represents best regression fit line.

Table 1**Participant Demographics and Alcohol-Related Measures**

	Mean (SD)
Demographics	
Age (years)	35.79 (3.22)
Education (years)	17.93 (3.35)
Sex (<i>n</i> male, %)	62 (58.49%)
Race (<i>n</i> Caucasian, %)	79 (74.53%)
<i>Family History</i>	
Positive	39 (36.79%)
Negative	44 (41.51%)
Could not classify	23 (21.70%)
Past month drinking behavior	
Frequency (drinking days/month)	12.42 (7.64)
Quantity (drinks/drinking day)	2.97 (2.01)
Maximum drinks/occasion	5.65 (4.18)
Heavy drinking frequency (days/month)	3.14 (5.22)
Other drinking measures	
AUD symptom count	0.99 (1.76)
AUDIT	6.30 (5.21)

Note: Data analyzed in *N*=106 participants. Data are mean (SD) or *n* (%). “Heavy drinking” defined as ≥ 5 drinks in an occasion for men or ≥ 4 for women. AUD = alcohol use disorder; AUDIT = Alcohol Use Disorders Identification Test.

Table 2

Anticipated and Laboratory-derived Alcohol Effects

Outcome	Anticipated alcohol effect ^a	Laboratory-derived alcohol effect: Rising limb BrAC ^b	Laboratory-derived alcohol effect: Peak BrAC ^c	Comparison ($p < .05$)
BAES Stim	31.5 (16.9)	23.4 (15.3)	22.5 (15.3)	a > b = c
B-BAES Stim	13.7 (7.7)	10.5 (7.1)	9.9 (7.2)	a > b = c
BAES Sed	22.3 (17.1)	14.0 (12.8)	17.6 (15.9)	a > c; a > b; c > b
B-BAES Sed	9.8 (8.7)	6.8 (7.1)	8.5 (8.2)	a > b; c > b
DEQ Like	63.0 (27.8)	57.0 (27.4)	54.1 (28.8)	a > b = c
DEQ Want	50.0 (33.0)	39.0 (33.7)	42.3 (34.3)	a > b = c

Note. Data analyzed in $N=106$ participants. Values are mean (SD). BAES = Biphasic Alcohol Effects Scale; B-BAES = Brief Biphasic Alcohol Effects Scale; Stim = Stimulation; Sed = Sedation; DEQ = Drug Effects Questionnaire; BrAC = Breath alcohol concentration. Within each outcome, post-hoc comparisons across assessments are denoted by superscript letters in the column labeled "Comparison" ($ps < .05$).

Table 3

Zero-order Correlations of Anticipated and Laboratory-derived Alcohol Effects at Rising Limb (below the diagonal) and Peak BrAC (above the diagonal)

	Anticipated responses						Laboratory-derived responses (at peak BrAC above the middle diagonal)					
	BAES Stim	B-BAES Stim	BAES Sed	B-BAES Sed	DEQ Like	DEQ Want	BAES Stim	B-BAES Stim	BAES Sed	B-BAES Sed	DEQ Like	DEQ Want
Anticipated responses												
BAES Stim	----	.97**	-.19	-.20*	.55**	.51**	.59**	.59**	-.16	-.18	.45**	.41**
B-BAES Stim	----	----	-.26**	-.27**	.52**	.48**	.55**	.57**	-.19	-.20*	.41**	.39**
BAES Sed	----	----	----	.98**	-.39**	-.40**	-.10	-.15	.53**	.48**	-.18	-.18
B-BAES Sed	----	----	----	----	-.38**	-.40**	-.10	-.16	.50**	.47**	-.16	-.16
DEQ Like	----	----	----	----	----	.78**	.36**	.34**	-.14	-.17	.64**	.53**
DEQ Want	----	----	----	----	----	----	.39**	.35**	-.19	-.19	.65**	.69**
Laboratory-derived responses (at rising BrAC below the middle diagonal)												
BAES Stim	.59**	.56**	-.10	-.11	.38**	.43**	----	.96**	-.16	-.16	.50**	.44**
B-BAES Stim	.60**	.60**	-.13	-.14	.38**	.42**	.95**	----	-.25*	-.24*	.48**	.38**
BAES Sed	-.16	-.18	.55**	.51**	-.17	-.10	-.05	-.12	----	.96**	-.20*	-.19*
B-BAES Sed	-.19	-.20*	.53**	.51**	-.20*	-.12	-.06	-.10	.96**	----	-.22*	-.19
DEQ Like	.40**	.38**	-.24*	-.23*	.58**	.57**	.48**	.47**	-.19	-.21*	----	.79**
DEQ Want	.35**	.32**	-.11	-.11	.53**	.59**	.50**	.52**	-.16	-.19*	.73**	----

Note. Data analyzed in N=106 participants. Correlations for rising limb BrAC outcomes are below the middle diagonal, correlations for peak BrAC outcomes are above the middle diagonal. Shaded/bolded cells represent correlations between anticipated and laboratory-derived counterparts; BAES = Biphasic Alcohol Effects Scale; B-BAES = Brief-Biphasic Alcohol Effects Scale; Stim = Stimulation; Sed = Sedation; DEQ = Drug Effects Questionnaire.

* $p < .05$;
** $p < .01$.

Table 4

Zero-order Correlations between Drinking Outcomes with Anticipated and Laboratory-derived Alcohol Effects at Rising Limb and Peak BrAC

Subjective Effects	Drinking quantity (past month)	Drinking frequency (past month)	Max. drinks/drinking day (past month)	Heavy drinking frequency (past month)	AUD symptom count	AUDIT
<i>Anticipated</i>						
BAES Stim	.23 *	.00	.22 *	.21 *	.28 **	.25 **
B-BAES Stim	.23 *	.01	.23 *	.22 *	.25 *	.24 *
BAES Sed	-.32 *	-.18	-.36 **	-.29 **	-.18	-.28 **
B-BAES Sed	-.28 **	-.18	-.34 **	-.27 **	-.17	-.26 **
DEQ Like	.33 **	.17	.35 **	.28 **	.32 **	.37 **
DEQ Want	.48 **	.31 **	.52 **	.44 **	.51 **	.56 **
<i>Laboratory-derived – Rising limb BrAC</i>						
BAES Stim	.31 **	.03	.30 **	.28 **	.25 **	.25 **
B-BAES Stim	.31 **	.06	.31 **	.30 **	.23 *	.25 *
BAES Sed	-.24 *	-.13	-.28 **	-.21 *	-.04	-.11
B-BAES Sed	-.24 *	-.14	-.30 **	-.21 *	-.03	-.07
DEQ Like	.33 **	.10	.27 **	.35 **	.24 *	.31 **
DEQ Want	.40 **	.21 *	.36 **	.38 **	.35 **	.38 **
<i>Laboratory-derived – Peak BrAC</i>						
BAES Stim	.19 *	-.05	.24 *	.20 *	.23 *	.11
B-BAES Stim	.18	.00	.24 *	.20 *	.20 *	.10
BAES Sed	-.22 *	-.18	-.27 **	-.19	-.08	-.14
B-BAES Sed	-.21 *	-.19	-.28 **	-.19	-.07	-.11
DEQ Like	.33 **	.10	.31 **	.30 **	.33 **	.28 **
DEQ Want	.39 **	.12	.37 **	.33 **	.40 **	.39 **

Note. Data analyzed in $N=106$ participants. BAES = Biphasic Alcohol Effects Scale; B-BAES = Brief-Biphasic Alcohol Effects Scale; Stim = Stimulation; Sed = Sedation; DEQ = Drug Effects Questionnaire; Drinking quantity = Drinks/drinking day; Drinking frequency = Total drinking days (past month); AUD = alcohol use disorder; AUDIT = Alcohol Use Disorders Identification Test.

* $p < .05$;

$p < .10$
**

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Table 5
 Hierarchical Multiple Regression with Anticipated Ratings Predicting Laboratory-derived Ratings of Subjective Alcohol Effects

Predictors	BAES Stim			B-BAES Stim			BAES Sed			B-BAES Sed			DEQ Like			DEQ Want		
	R^2	β	R^2	β	R^2	β	R^2	β	R^2	β	R^2	β	R^2	β	R^2	β	R^2	β
<i>Rising Limb BrAC</i>																		
Step 1	.13**		.12*		.10*		.11*		.17**		.18***							
Heavy drinking frequency	.25**		.27**		-.30**		-.31**		.30**		.41***							
Sex	.10		.06		-.02		-.07		-.01		.01							
FH+ versus FH- ^a	.15		.13		-.05		-.04		.19		.02							
FH unknown versus FH- ^a	-.07		-.07		-.09		-.10		-.06		-.05							
Step 2	.26***		.28***		.24***		.21***		.24***		.19***							
Heavy drinking frequency	.13		.14		-.13		-.17		.13		.16							
Sex	.01		-.02		-.16		-.17		-.03		.09							
FH+ versus FH- ^a	.09		.06		.06		.07		.10		-.06							
FH unknown versus FH- ^a	-.07		-.07		-.01		-.03		-.07		.02							
Session	.07		.07		.09		.09		-.15		-.09							
Anticipated measure	.55***		.57***		.54***		.50***		.51***		.53***							
<i>Peak BrAC</i>																		
Step 1	.07		.07		.09*		.09*		.12**		.21***							
Heavy drinking frequency	.20*		.21*		-.31**		-.31**		.30**		.35***							
Sex	.15		.14		-.04		-.07		-.10		-.10							
FH+ versus FH- ^a	.05		.04		.02		.04		.06		.08							
FH unknown versus FH- ^a	-.08		-.05		.01		.01		-.06		-.17							
Step 2	.30***		.28***		.24***		.19***		.33***		.28***							
Heavy drinking frequency	.07		.08		-.15		-.18		.08		.03							
Sex	.05		.05		-.17		-.16		-.14		-.01							
FH+ versus FH- ^a	-.01		-.02		.13		.14		-.03		-.01							
FH unknown versus FH- ^a	-.08		-.06		.08		.07		-.08		-.09							

Predictors	BAES Stim			B-BAES Stim			BAES Sed			B-BAES Sed			DEQ Like			DEQ Want		
	R ²	β	R ²	β	R ²	β	R ²	β	R ²	β	R ²	β	R ²	β	R ²	β	R ²	β
Session		.13		.12		.10		.06		-.05		.01		-.05		.01		.01
Anticipated measure		.60***		.58***		.54***		.47***		.62***		.66***		.62***		.66***		.66***

Note.

^aFamily history and sex were dummy-coded prior to entry into the model; for family history, the FH- group served as the reference category. Data analyzed in N=106 participants. For all models, adding the Session x Anticipated measure interaction term to the model in step 3 (data not shown) did not improve the model fit (see text). BrAC = Breath alcohol concentration; Session = session order (alcohol first or placebo first); BAES = Biphasic Alcohol Effects Scale; B-BAES = Brief-Biphasic Alcohol Effects Scale; Stim = Stimulation; Sed = Sedation; DEQ = Drug Effects Questionnaire.

* $p < .05$,
** $p < .01$,
*** $p < .001$.