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# The Drug Effects Questionnaire: Psychometric Support across Three Drug Types

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## Abstract

**Rationale—**The Drug Effects Questionnaire (DEQ) is widely used in studies of acute subjective response (SR) to a variety of substances, but the format of the DEQ varies widely across studies, and details of its psychometric properties are lacking. Thus, the field would benefit from demonstrating the reliability and validity of the DEQ for use across multiple substances.

**Objective—**The current study evaluated the psychometric properties of several variations of DEQ items, which assessed the extent to which participants (1) feel any substance effect(s), (2) feel high, (3) like the effects, (4) dislike the effects, and (5) want more of the substance using 100mm Visual Analog Scales.

**Methods—**DEQ data from three placebo-controlled studies were analyzed to examine SR to amphetamine, nicotine, and alcohol. We evaluated the internal structure of the DEQ for use with each substance as well as relationships between scale items, measures of similar constructs, and substance-related behaviors.

**Results—**Results provided preliminary psychometric support for items assessing each DEQ construct (FEEL, HIGH, DISLIKE, LIKE, and MORE).

**Conclusions—**Based on the study results, we identify several common limitations of extant variants of the DEQ and recommend an improved version of the measure. The simplicity and brevity of the DEQ combined with its promising psychometric properties support its use in future SR research across a variety of substances.

Research on subjective response (SR) to acute drug administration has provided valuable information about individual differences in responses to alcohol and other substances and their relation to abuse-related outcomes including abuse potential, quantity and frequency of use, and negative consequences of use. One of the measures most commonly used to assess SR is the Drug Effects Questionnaire (DEQ), which assesses two key aspects of subjective experience: (1) the strength of substance effects and (2) desirability of substance effects (de Wit and Phillips, 2012). The DEQ has been used with a wide range of substances. Some

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examples include alcohol (King *et al.*, 2011, Reed *et al.*, 2012), alprazolam (Evans and Levin, 2002), amphetamine (Dlugos *et al.*, 2011, Hamidovic *et al.*, 2010), baclofen (Evans and Bisaga, 2009); buprenorphine and methadone (Comer *et al.*, 2005a), cocaine and lidocaine (Fischman *et al.*, 1983), heroin (Comer *et al.*, 2005b), methamphetamine (Johnson *et al.*, 2005), MDMA (Harris *et al.*, 2002), morphine (Webster *et al.*, 2011), nicotine (Sofuoglu *et al.*, 2012), nitrous oxide (Zacny and Jun, 2010), oxycodone (Webster *et al.*, 2012), pentobarbital (Cole-Harding and de Wit, 1992), and tetrahydrocannabinol (Phan *et al.*, 2008, Wachtel and de Wit, 2000).

Recently, a five-item version of the DEQ was recommended for use as an acute measure of SR by the PhenX Toolkit (Hamilton *et al.*, 2011), a web-based catalog of high quality measures recommended for inclusion in human subjects research by the National Institutes of Health and the National Human Genome Research Institute. This version of the DEQ includes the following items: “Do you feel a drug effect right now?” (FEEL); “Are you high right now?” (HIGH); “Do you like any of the effects you are feeling right now?” (LIKE); “Do you dislike any of the effects you are feeling right now?” (DISLIKE); and “Would you like more of the drug you took, right now?” (MORE). Although the items included in the version of the DEQ recommended by PhenX reflect some of the more commonly assessed constructs (i.e., FEEL, HIGH, LIKE, DISLIKE, and MORE), there is no *official* version of the DEQ that is used consistently by researchers in the field. Many different versions have been used across studies, which have varied considerably in length (e.g., 2-10 questions) and response format. For example, response options have consisted of either visual analog scales (i.e., VAS) or Likert-type scales and may have a unipolar or bipolar format (e.g., responses for LIKE may range from “not at all” to “very much” or from “dislike very much” to “like very much”). Given the number of existing variations, it is not surprising that the DEQ does not have a clear origin as an independent assessment tool. Instead of a single reference to a standardized scale, articles refer to a variety of original sources (e.g., Evans *et al.*, 2000, Fischman and Foltin, 1991, Folstein and Luria, 1973, Fraser *et al.*, 1961) or refer to the DEQ as “locally developed,” indicating that clear and citable psychometric properties are not available for report (e.g., Fischman *et al.*, 1983, White *et al.*, 2002). Further, several other questionnaires include items closely related to the DEQ (e.g., Drug Liking Index, End of Session Questionnaire, Drug Liking Scale, Drug effects/Liking/Take Again Questionnaire, Single Dose Questionnaire, and the degree of overlap among these questionnaires is unknown. Most importantly, no DEQ version has undergone sufficient psychometric evaluation to support its use as a reliable and valid assessment of the strength and desirability of drug effects.

The substance field would benefit greatly from the use of a standardized, psychometrically sound version of the DEQ that would improve the assessment of acute substance effects and facilitate comparisons across studies. Working toward this goal, the current study had two aims: 1) to evaluate the psychometric properties of several variants of five commonly used DEQ items (FEEL, HIGH, DISLIKE, LIKE, and MORE; (Hamilton et al., 2011) for use with amphetamine, nicotine, and alcohol, and 2) to recommend an empirically improved version of the DEQ based on the results of the study.

Within the current study, several versions of the DEQ were used to assess the three substances. Specifically, the versions varied in terms of instructional set, item order, item format (e.g., question versus statement), and response choice (e.g., “not at all” to “extremely” versus “not at all” to “very much”; see Table 1). Although there was variability across the DEQ *items*, there was sufficient data to evaluate the utility of assessing each of the five *constructs* (i.e., FEEL, HIGH, LIKE, DISLIKE, MORE).

Evidence for the reliability and validity of the respective DEQ items was gathered from the following psychometric evaluations: (1) the DEQ's ability to discriminate between placebo and active substance effects as well as across doses, (2) construct validity (i.e., underlying factor structure), (3) convergent validity, and (4) test criterion validity. Across substances, the DEQ items were expected to discriminate active drug effects from placebo effects and to discriminate between active doses of a given drug (e.g., 10 versus 20mg of amphetamine). Although published psychometric information on the internal structure of the DEQ is absent, the DEQ items have traditionally been conceptualized as independent constructs. However, the types of effects assessed by the DEQ may actually represent aspects of a single construct (i.e., the experience of drug effects). Therefore, both single-factor and multi-factor latent structures were considered. Predicted relationships between the DEQ items and alternative measures of subjective experience were based on shared valence such that LIKE and MORE were expected to relate to positive subjective experiences and DISLIKE was expected to relate to negative experiences. No specific hypotheses were outlined for items FEEL and HIGH. Finally, relationships between the DEQ items and drug taking have been evaluated as an indicator of abuse potential within a laboratory context, but it is less clear the extent to which the experience of these effects in a laboratory setting relates to use outside of the laboratory (for a review related to early subjective experience see de Wit and Phillips, 2012). Although many factors influence substance use (e.g., prior history, availability, legality, social norms, anticipated or actual consequences), we expected that SR in the laboratory would relate to real-world use, especially in cases in which participants had a documented history of using the substance administered in the laboratory (e.g., alcohol and nicotine).

## METHOD

### Participants and Procedures

Data from three separate placebo-controlled, within subjects studies were used for the current investigation. The datasets examined acute responses to oral amphetamine [de Wit, unpublished DEQ data], intravenous nicotine (Sofuoglu et al., 2012), and oral alcohol (King et al., 2011). Table 2 depicts a brief summary of the three parent studies, including participant demographics and procedures employed in data collection. Across studies, a total of 687 participants were recruited from either community or college samples. The amphetamine and alcohol studies included participants who adequately represented both male and female genders (mean % male across studies = 54.5), were comparably aged (mean age = 24.6), and overrepresented participants of Caucasian descent (mean = 87.6%). The nicotine dataset comprised older participants (mean age = 37.4[8.7]) who were majority male (% male = 70.5). Caucasian and African American backgrounds were equally represented (% Caucasian = 46.5; % African American = 42.4).

### Measures

#### Main measure

**Drug Effects Questionnaire:** The DEQ versions used in each study employed a 100mm visual analog scale (VAS) anchored by "not at all" and variants of "extremely" (e.g., "very strong"; "very much") to capture the post-drug experience of FEEL, HIGH, and MORE. The greatest discrepancy across studies was in the assessment of LIKE and DISLIKE. Most similar to the version recommended by PhenX, LIKE and DISLIKE were evaluated within the amphetamine study using separate unipolar scales anchored by either "not at all" or "neutral" and "LIKE/DISLIKE a lot." Independent samples t-tests indicated that participants' responses were not statistically different depending on the anchors used to assess SR to amphetamine ($p$-values > .10). Within the alcohol study, LIKE and DISLIKE were assessed with a single bipolar response scale with VAS anchors ranging from "dislike

very much" to "like very much" with "neutral" in the middle. Within the nicotine study, DISLIKE was not explicitly assessed. Rather, an item assessing "I feel bad drug effects" was substituted for DISLIKE. Although "I feel bad drug effects" is unlikely to be the same as DISLIKE, there is reason to believe that these items may evidence significant overlap. First, these items have demonstrated significant overlap in a prior nicotine administration study (correlations ranging from .77-.79; Blank et al., 2007). Second, both "I feel *GOOD* drug effects" and "I LIKE the drug effect" were explicitly assessed in the nicotine study. The magnitude of the correlation between these items ($r$ = .75) indicated that "I feel good drug effects" would be a reasonable proxy for LIKE in the current study, and the strength of the correlation was also consistent with those observed between DISLIKE and BAD DRUG EFFECTS in previous work (Blank et al. 2007). Based on these two pieces of evidence, we inferred that "I feel bad drug effects" would be a reasonable proxy for DISLIKE.

**Additional measures used to evaluate validity:** Data from other relevant self-report measures were obtained as possible from each parent study. Additional assessments of subjective experience after drug administration were obtained to assess convergent validity and self-reported frequency of use of substances similar to the drug in a given study (i.e., lifetime stimulant use in the amphetamine study; daily cigarettes smoked in the nicotine study; quantity /frequency of drinking in the alcohol study). Within the alcohol study, data were also gathered on alcohol use and related consequences assessed at the two year post-laboratory follow up. See Table 2 for a list of additional assessments by study.

**Measures used to evaluate convergent validity—**The following measures were also assessed after drug administration in several of the datasets. In the analysis, only the scores corresponding to the post drug interval with peak FEEL were analyzed.

**Profile of Mood States:** (POMS; McNair, 1971). The POMS is a 72-item measure that assesses various affective states. Participants rated the extent to which they experienced each of 72 affective states using a 5-point scale ranging from "not at all" to "extremely."

**Addiction Research Center Inventory:** (ARCI; Martin *et al.*, 1971). The ARCI is a 49-item true-false scale that assesses participant sensitivity to several drug effect categories including: Amphetamine-like effects (e.g., increased energy, sense of well being), Benzedrine-like effects (e.g., increased energy, intellectual productivity), Morphine-Benzedrine-like effects (e.g., pleasant somatic experiences, euphoria), Lysergic Acid Diethylamide-like effects (e.g., dysphoria, somatic discomfort), and Pentobarbital-Chlorpromazine-Alcohol-like effects (e.g., sedation, psychomotor retardation).

**The Biphasic Alcohol Effects Scale:** (BAES; Martin *et al.*, 1993). The BAES is a 14-item measure that assesses alcohol-induced stimulation (e.g., energized, talkative) and sedation (e.g., heavy head, slow thoughts). Participants rated their subjective experience of each alcohol effect on an 11-point rating scale from "not at all" to "extremely."

### Measures used to evaluate test criterion validity

**Stimulant Use:** Participants reported on lifetime frequency of stimulant use.

**Cigarette Smoking:** A single item assessed typical number of cigarettes smoked daily.

**The Brief Questionnaire on Smoking Urges:** (BQSU; Cox *et al.*, 2001). The BQSU is a 10-item measure that assesses cigarette craving (e.g., All I want right now is a cigarette). Based on the factor analysis conducted by Toll *et al.* (2006), the BQSU includes two factors: global intent to smoke and desire to relieve negative affect. Data were collected at baseline,

(i.e., before nicotine administration) and at the end of the study after all doses of nicotine were administered.

**Timeline Follow-back:** (TLFB; Sobell and Sobell, 2003). The TLFB is an experimenter-administered interview which assesses the quantity and frequency of drinking in the past month. In the alcohol study, data are included from baseline (N=294) and the year 2-follow (N=190).

**Alcohol Use Disorders Identification Test:** (AUDIT; Saunders *et al.*, 1993). The AUDIT is a 10-item self-report measure that assesses alcohol-related negative consequences (e.g., Have you/someone else been injured as a result of your drinking?). In the alcohol study, data are included from baseline (N=294) and the year 2 follow-up (N=190).

## Data Analytic Plan

**Data preparation—**To facilitate the comparison of findings across the four datasets, we used DEQ ratings for all items that corresponded with the time point (e.g., baseline, time 1, time 2) at which individuals reported the strongest experience for the item "Do you feel a drug effect right now" (i.e., peak FEEL)[1]. Across the three datasets, ten individuals reported feeling no drug effects (peak FEEL = 0) and were not included in the analyses (n = 6 for amphetamine; n = 3 for nicotine; n = 1 for alcohol).

**Discriminating drug from placebo effects—**A good measure of substance effects must be able to reliably detect them. Therefore, paired samples t-tests were used to evaluate whether the DEQ items reliably discriminated drug effects from placebo effects and whether they were sensitive to drug dose.

**Construct Validity—**To test the possibility that the DEQ items reflect several aspects of a single construct (i.e., the experience of drug effects) rather than distinct constructs, we used a CFA approach within MPLUS 5.1 (Muthén and Muthén, 1998-2008) to fit a single factor model comprising all five of the DEQ items to the data for amphetamine and nicotine. For alcohol, LIKE and DISLIKE were assessed using a single bipolar item, so a four item factor was specified. Robust maximum likelihood estimation (ESTIMATOR= MLR) was used, as this estimation method is robust to both nonnormality and non-independence of observations and produces a range of fit indices that are helpful in determining latent factor structure.

**Convergent validity—**Bivariate correlations were conducted to evaluate the relationships between the DEQ items and the following alternative measures of subjective experience: the POMS (amphetamine); the ARCI (amphetamine and alcohol); and the BAES (alcohol).

**Test-criterion validity—**First, multiple regression analyses were used to evaluate whether participants' DEQ responses to amphetamine, nicotine, and alcohol, respectively, were related cross-sectionally to their use of similar substances. Specifically, SR to amphetamine was examined in relation to lifetime stimulant use, SR to intravenous nicotine was examined in relation to baseline smoking frequency, and SR to alcohol was examined in relation to the frequency of alcohol use over the past month and to the experience of negative alcohol-related consequences. Gender, race, and age were entered as covariates in the models for

[1]For amphetamine and nicotine, the absolute peak values for HIGH, LIKE, DISLIKE, and MORE were computed (e.g., the time point at which LIKE was strongest). For alcohol, all DEQ items corresponded to the peak blood alcohol level. Correlations between the value of each item at peak FEEL and its respective peak value (e.g., the value of LIKE at peak FEEL versus the value of LIKE at peak LIKE) were strong, ranging from .83 to .98 across all substances and doses (mean correlation for amphetamine = .95; for nicotine = .91).

nicotine and alcohol. Only gender and age were entered as covariates in the model for amphetamine because all participants were of Caucasian descent.

Second, multiple regression analyses were conducted to assess predictive validity for nicotine (e.g., DEQ responses to nicotine → BQSU urge ratings later in the session) and alcohol (DEQ responses to alcohol → drinking frequency and AUDIT scores at follow up). As with the prior models, gender, race, and age were included as covariates in each model. Baseline smoking urges were also included in the model predicting post-nicotine administration urge to smoke. Of note, while in the alcohol study (King et al, 2011) drinkers were recruited to fit either heavy or light drinking criteria, the predictive validity analyses focused on two outcome variables that were normally distributed across the combined sample: frequency of drinking over the past month and AUDIT scores.

As noted above, separate regression model were run for each individual DEQ item. We employed false discovery rate control (FDR; Benjamini & Hochberg, 2000) to account for the multiple comparisons. Rather than rank ordering the significance levels of each of the covariates, the significance level associated with the block of covariates was taken into consideration. The tolerance level for Type I error was set to the traditional alpha value of .05.

## RESULTS

### Discriminating Drug from Placebo Effects (see Table 3)

Paired-samples t-tests revealed that participants' subjective experience of FEEL, HIGH, LIKE, DISLIKE, and MORE reliably discriminated drug from placebo effects across all substances. The subjective experiences of each of the DEQ items were rated *stronger* after administration of amphetamine, nicotine, and alcohol than after placebo, with the exception of a decrease in DISLIKE following amphetamine administration. Effect sizes for the items were generally moderate to large, adding further confidence that the respective DEQ items reliably detect effects for each of the substances evaluated. Regarding dose effects, paired samples t-tests revealed that participants' subjective experience of FEEL, HIGH, LIKE, and MORE discriminated between different doses for each substance except nicotine (i.e., stronger for the higher versus lower dose). DISLIKE/BAD DRUG EFFECTS did not discriminate between drug doses. To minimize redundancy, the results associated with the strongest dose are presented in the text and tables that follow.

### Construct Validity: Confirmatory Factor Analysis

A single factor model including all five DEQ items (four items for alcohol) did not provide adequate fit to the data for any of the three substances as evidenced by one of more of the following model fit indices: Bentler's Comparative Fit Index < .90, Tucker Lewis Index < .90, Root Mean Square Error of Approximation > .08, and Standardized Root Mean Square Residual > .08 (results not presented). Weak loadings (< .25) for DISLIKE for amphetamine and nicotine suggested DISLIKE may represent a separate factor. Therefore a second model was specified in which DISLIKE was specified as the first factor (i.e., the loading was fixed to 1) and items FEEL, HIGH, LIKE, and MORE comprised a second factor. Again, the model did not fit the data for either substance (see Table 4).

Given the absence of prior published work on the latent structure of the DEQ, we reviewed within each model item factor loadings, modification indices, and inter-item correlations for signals of a reliable latent structure. When the models were examined across the substances, either items LIKE/MORE or items FEEL/HIGH loaded more strongly onto the identified factor with the other pair of items evidencing weaker loadings (See Table 4). Modification indices were consistent with the pairings of FEEL/HIGH and LIKE/MORE (columns

labeled “Modification Indices”) as were inter-item correlations (columns titled “Inter-Item Correlations”). Although items FEEL, HIGH, LIKE, and MORE all were strongly correlated with one another across substances, the magnitude of the relationships between items FEEL and HIGH and between items LIKE and MORE observed for amphetamine and for alcohol raised concerns about possible nonindependence of these items based on established criteria for evaluating multicollinearity ($r > .80$; Meyers *et al.*, 2006).

At this point in time, the brevity of the DEQ became a limiting factor in evaluating latent structure. When considered in concert, the item loadings, modification indices, and inter-item correlations suggested that model fit was compromised by the presence of strong relationships between items FEEL and HIGH and items LIKE and MORE for each substance. The presence of these item pairings suggested two possibilities. First, the DEQ items actually reflect a single latent factor, but redundant items must be dropped to improve model fit. A second possibility is that items FEEL and HIGH and items LIKE and MORE actually reflect two separate latent factors. Unfortunately, considering both the single-factor and two-factor solutions presented the same dilemma. With respect to the single factor solution, modification indices (and inter-item correlations) indicated that it was necessary to drop two items from our model (one from each item pairing), which would result in a latent factor comprising only two items. Fitting a two factor model based on the pairings of items FEEL and HIGH and items LIKE and MORE would have posed the same concern; each identified factor would contain only two items. The minimum number of items considered sufficient for being considered a proper “subscale” and estimating latent variables is 3 (e.g., Jöreskog and Sörbom, 1989, Levitt *et al.*, 2009). Thus, while it was clear that a single-factor solution could not be fit to the DEQ items we assessed, it was impossible to evaluate further the latent structure given the limited number of items. As such, the DEQ items were analyzed as distinct, albeit significantly related, constructs.

### Convergent Validity: The DEQ Items and Alternative Measures of Subjective Experience

Across substances, common patterns of relationships between the DEQ items, affective experiences, and substance-induced effects were observed (see Table 5). LIKE and MORE were associated with a range of positive subjective experiences including feeling friendly, elated, and vigorous (assessed using the POMS); experiencing increased energy, positive somatic experiences, and euphoria similar to the effects of amphetamine, Benzedrine, and morphine (assessed using the ARCI); and feeling pleasant alcohol-induced stimulation (assessed using the BAES). Where statistically significant inverse correlations emerged for LIKE and/or MORE, they were consistent with the pattern of findings observed for the positive correlations related to mood and substance-induced affective experiences. For example, after amphetamine administration, stronger MORE was associated decreased feelings of fatigue and confusion on the POMS and with fewer sedative impairing effects associated with pentobarbital on the ARCI. This pattern is consistent with the relationships observed between MORE and vigor (POMS) and the positive, stimulant effects of amphetamine and Benzedrine (ARCI).

FEEL and HIGH were generally associated with the same positively valenced subjective experiences across substances as were LIKE and MORE. However, experiences of FEEL and/or HIGH were also associated with negatively valenced experiences including anxiety and anger (POMS) after amphetamine administration; LSD-like dysphoria (ARCI) after amphetamine and alcohol administration, and sedation (BAES) after alcohol administration. After amphetamine administration, DISLIKE was associated with increases in the negative affective experiences (e.g., anxiety, depression, fatigue, anger, confusion) and decreases in positive affective experiences (e.g., elation, vigor) assessed by the POMS. Similarly, after amphetamine administration, positive correlations were observed between DISLIKE and negatively valenced substance-induced experiences assessed by the ARCI including LSD-

like dysphoria and pentobarbital-like sedation, while inverse correlations were observed with positive substance-induced experiences like those associated with the characteristic effects of Benzedrine.

### Test-Criterion Validity: Relationships between the DEQ Items and Substance Behaviors

**Concurrent validity—**For amphetamine and alcohol, each of the DEQ items assessed was associated with cross-sectional substance use with the exception of DISLIKE. LIKE and MORE were associated with more frequent stimulant use ($p$ <.001; $p$ = .027) as well as with greater baseline drinking frequency and higher AUDIT scores ($p$-values < .001; see Table 6). Regarding FEEL and HIGH, stronger effects were associated with more frequent lifetime stimulant use ($p$ = .01; $p$ = .001, respectively) but with lower baseline drinking frequency and AUDIT scores ($p$-values < .001). Finally, stronger experiences of DISLIKE after amphetamine were not significantly associated with lifetime stimulant use ($p$ = .06). For nicotine, weaker LIKE and MORE were associated with heavier baseline smoking at a significance level of $p$ < .05. However, after employing the FDR correction, subjective response to intravenous nicotine was not associated significantly with baseline levels of smoking.

**Predictive validity—**Although SR to intravenous nicotine was not associated with baseline smoking, it was associated with smoking urges after the nicotine administration session. Specifically, weaker experiences of FEEL, HIGH, and MORE and stronger experiences of DISLIKE (i.e., “Feel bad drug effects”) after IV nicotine administration were associated with stronger global smoking urges and/or stronger urges to smoke to relieve negative affect ($p$-values < .05; Table 7). Regarding alcohol, stronger experiences of LIKE and MORE and weaker experiences of FEEL predicted more frequent alcohol use ($p$-values < .05) and higher AUDIT scores ($p$-values < .001) at two-year follow up. After employing the FDR correction, all results remained significant with the exception of the relationship between MORE and global desire to smoke following nicotine administration.

## DISCUSSION

The first goal of the current study was to provide preliminary psychometric support for the use of five constructs that are commonly assessed by DEQ variants (FEEL, HIGH, LIKE, DISLIKE, and MORE; Hamilton et al., 2011). To this end, we evaluated the psychometric properties of several variants of the five DEQ items, which differed with respect to item format and response anchors. Across substances, we found preliminary psychometric support for the use of each of the item variants. All item variants reliably discriminated drug from placebo responses, providing solid evidence that experiences of each of the DEQ items reflect genuine pharmacological substance-induced effects. Further, the variants of items FEEL, HIGH, LIKE, and MORE were reliably dose-dependent across substances with the exception of nicotine.

Consistent with extant theory and practice, the results of the construct validity analyses provided support for the conceptualization of the DEQ items as unique, albeit significantly related, constructs as opposed to a unitary construct. The DEQ items also evidenced convergent validity in relation to measures often administered alongside the DEQ in laboratory paradigms (i.e., ARCI, POMS, and BAES). As anticipated, items LIKE and MORE were associated most strongly with positive drug experiences (e.g., euphoria, energy/increased productivity) and mood states (e.g., feeling friendly, elated, vigorous). Also as expected, DISLIKE was associated with negative subjective experiences. Further, items FEEL and HIGH were associated with the same positive outcomes as LIKE and MORE but were also associated with negative drug experiences (e.g., dysphoria and physical

discomfort associated with LSD), negative mood states (e.g., anxiety, anger), and alcohol-induced sedation. This pattern suggests that FEEL and HIGH may capture the experience of a broader range of substance-induced effects than LIKE, MORE, and DISLIKE, which appeared to have an inherently positive or negative valence within the current study.

As mentioned previously, the DEQ has been used widely, and its continued popularity is likely the result of the fact that DEQ variants have demonstrated utility in assessing substance effects across a range of different drugs in laboratory settings. However, doubts have been raised about the extent to which a profile of DEQ responses should correspond to substance use outside the laboratory (e.g., de Wit & Phillips, 2012). Although it is important to acknowledge that numerous factors are at play in determining substance use and that future research is needed before any strong conclusions can be made, the results of the current study provide preliminary evidence that DEQ responses may meaningfully relate to substance use in a real life context for some substances of abuse.

After amphetamine administration, stronger experiences of FEEL, HIGH, MORE and LIKE were cross-sectionally related to lifetime history of stimulant use. With respect to nicotine, weaker experiences of FEEL, HIGH, and MORE and stronger experiences of DISLIKE predicted stronger urges to smoke at the end of the session. These findings may initially appear counterintuitive, as one might expect *stronger* positive effects of nicotine to be associated with subsequent urge to smoke. However, these findings may reflect, in part, the novel route of nicotine administration. Smokers more physiologically dependent on nicotine may also show more psychological addiction to the behavioral aspects of smoking cigarettes (e.g., handling a cigarette, sensory aspects of inhaling smoke, etc.) than those with less physiological dependence. As such, they may be less responsive to intravenous nicotine delivery, which physiologically reduces nicotine withdrawal effects but lacks most of the cues associated with typical nicotine delivery via smoking. Finally, with respect to alcohol, stronger experiences of LIKE and MORE were associated with more frequent alcohol use and higher AUDIT scores at the time of the first alcohol administration session and at the two-year follow-up. Perhaps reflecting the development of tolerance to the effects of alcohol, weaker experiences of FEEL were associated with heavier alcohol use and with higher AUDIT scores over the course of the study. Similarly, weaker experiences of HIGH were associated with higher AUDIT scores at the time of the first session.

The present study has a number of important strengths, but several limitations also merit consideration. Statistically significant findings related to the DEQ had been published previously from the nicotine and alcohol datasets that we used to conduct the current set of analyses. Given that our analyses for nicotine and alcohol relied on datasets in which the DEQ was known to have utility, it is not possible to determine from the current study how often the DEQ fails to perform as expected in these substances (and other substances that were not assessed). These concerns are mitigated, however, by the fact that we found psychometric support for the DEQ for use with amphetamine using a dataset from which no DEQ data had been published previously.

A second concern related to the three parent studies is that they differed with respect to study sample and methodological design. Across studies participants varied with respect to age, race, and substance use status. For example, participants in the nicotine study were older, more likely to be male, and had a higher representation of African American compared to participants in the amphetamine and alcohol studies who were younger, equally represented both genders, and had a majority of Caucasians. Further, the amphetamine study included healthy, non-dependent individuals, while participants in the nicotine study were at least moderately addicted and in withdrawal at the time of participation, and 70% of the participants in the alcohol study were regular binge drinkers. Gender, age, and race were

included as covariates in the statistical models to account for their influence on substance use outcomes, but it is unclear how well the DEQ items would relate to one another and to outcomes of interest across the continuum of age, race, and substance use status (i.e., non-users, experimental and regular users, and dependent users).

Regarding study design, only the nicotine and alcohol studies had data relevant to predictive validity analyses, so relationships could not be assessed for amphetamine. It should also be noted that the present analysis was conducted across three common substances that have high abuse potential, and it is unclear whether the pattern of relationships observed within the current study would be replicated with drugs that have greater potential for negative effects (e.g., LSD, ketamine, nitrous oxide). Furthermore, different patterns of use may confer increased risk across the substances included in the current study (e.g., binging for alcohol and amphetamine; steady use for nicotine), and it remains to be seen whether the DEQ can discriminate risk profiles.

Also related to study design, each of the parent studies employed a double-blind, placebo-controlled, laboratory-based substance administration paradigm to assess acute subjective response. Although studies using the DEQ often employ this study design, the rationale for doing so varies. Similar to the aims of the parent studies, one reason may be to characterize the drug effects in a particular individual or within a group of interest (e.g., alcohol dependent individuals) to better understand subjective response in relation to substance use outcomes. Another reason may be evaluating the impact of administering a potential antagonist or a pharmacological enhancer on subjective response with repeated administration or during a period of acute abstinence. Assessing the validity of the DEQ for use in a repeated measures design or in concert with an agonist or antagonist will be an important subject for future study.

It is also important to consider the ramifications of our decision to link participants' subjective experience of FEEL, HIGH, DISLIKE, LIKE and MORE to the point in time at which they reported the strongest substance effects (peak FEEL). A different pattern might have emerged if the time point at which the highest subjective liking or plasma level of drug was used. However, strong correlations between the value of each item at peak FEEL and at its respective peak value (e.g., the value of LIKE at peak FEEL compared to the value of LIKE at peak LIKE) were observed for amphetamine and nicotine (mean values > .90), suggesting that a similar pattern of results may emerge if SR were tethered to the peak experience of a different item (e.g., LIKE).

Several issues related to the assessment the DEQ items should be considered in the context of study limitations. Several versions of the DEQ were used to assess SR within the current study. These versions varied in terms of instructional set, item order, the assessment of DISLIKE, item format (i.e., question versus statement), and item response anchors. Unfortunately, it was not possible to evaluate the extent to which discrepancies in instructional set, item order, and item format may have influenced SR. However, the fact that we obtained significant results across substances suggests that these discrepancies likely have a minimal impact. When considering the importance of assessing DISLIKE, this construct was assessed explicitly and as an independent item only within the amphetamine study (where it was unrelated to lifetime stimulant use). Within the nicotine study, participants' responses to the item "I feel bad drug effects" were considered a proxy for DISLIKE in the absence of an item explicitly assessing this construct. This decision was based on a strong relationship observed between items LIKE and "I feel GOOD effects" in the current study and on results of a previous study in which subjective experiences of DISLIKE and BAD DRUG EFFECTs after nicotine administration were correlated strongly ( However, it is unclear to what extent the pattern of results observed in the current study

would be replicated if "DISLIKE" had been assessed explicitly. Within the alcohol study, LIKE/DISLIKE were assessed using a single bipolar scale with response options ranging from "dislike very much" to "like very much." The results of the current study found support for the utility of the bipolar item, but the fact that both items LIKE and DISLIKE accounted for unique variability in outcomes related to amphetamine and nicotine use speaks to the value of assessing these constructs independently. Finally, the item response anchors differed across the DEQ versions used in the current study. Each item was assessed within the nicotine and alcohol studies using a 100mm visual analog scale (VAS) anchored by "not at all" and variants of "extremely" (e.g., "very strong"; "very much"). Items FEEL, HIGH, and MORE were assessed using a similar format within the amphetamine study, but a subgroup of the participants in the amphetamine study reported on LIKE and DISLIKE using anchors "neutral" and "LIKE/ DISLIKE a lot" while other reported using anchors "not at all" and "LIKE/DISLIKE a lot." Independent samples *t*-tests suggested that participants' responses were not significantly different depending on whether "neutral" or "not at all" was used to anchor the LIKE and DISLIKE scales used to assess SR to amphetamine. However, it was not possible to evaluate further the extent to which discrepancies response anchors may have translated to meaningful differences in the variability of participant responses across substances.

In moving toward a standardized version of the DEQ, it is important to consider the lessons to be learned from the current study's strengths and limitations. Consistent with the first goal of the study, we found psychometric support for the importance of assessing each of the five DEQ constructs (FEEL, HIGH, DISLIKE, LIKE, and MORE) across several common substances of abuse. As a result of conducting the current study, we also identified several complications associated with using different variants of the DEQ. In light of these strengths and limitations, we propose an empirically improved version of the DEQ (see Figure 1) along with several recommendations for using the measure.

## The DEQ-5

**Instructional Set—**We made several changes to the instructional set to improve overall clarity and to make the measure accessible to a broader range of participants. First, we eliminated or explicitly defined more advanced vocabulary terms (i.e., "adjective" and "vertical"). Second, to facilitate the scoring of the visual analog scale (VAS), we explicitly instruct participants to mark their SR using a vertical line. Without a specific prompt, participants may indicate their SR on a paper-and-pencil version of the DEQ using an "X," a checkmark, or another symbol which makes scoring the VAS more difficult. Finally, we provide an example item (i.e., "Do you feel dizzy right now?").

**Item Format—**The DEQ-5 comprises five items: FEEL, HIGH, DISLIKE, LIKE, and MORE. Each item is assessed with a separate, unipolar 100mm visual analog scale as opposed to a unitary bipolar scale to assess DISLIKE and LIKE.

**Item Order—**The current study suggested clear pairings of items FEEL and HIGH and items LIKE and MORE across substances. Therefore, we have reconfigured the order of the DEQ items to reflect these pairings (i.e., FEEL, HIGH, DISLIKE, LIKE, MORE). This structure allows participants to consider their experience of each effect prior to deciding if they would like MORE. This structure also progresses from terms with an ambiguous valence (FEEL, HIGH) to terms with a clear negative or positive valence (DISLIKE, LIKE).

## Recommendations for Using the DEQ-5

**1. To help ensure that participants' DEQ responses reflect SR to the active substance that was administered rather than their general affective state or expectations,**

**consider including only participants who report experiencing a drug effect (i.e., FEEL > .00) in statistical analyses:** Given that the DEQ is designed to assess SR to pharmacological drug effects, we only analyzed data from participants who reported feeling some magnitude of drug effect (i.e., FEEL > .00). Across studies, 10 participants reported feeling no effects, so their DEQ data was not included. While the absence of a drug effect in a small subsample of individuals is not cause for concern on its own, we noticed that several participants who reported not feeling any drug effects reported non-zero values for at least one additional DEQ item (i.e., HIGH, LIKE, DISLIKE, MORE). In most cases, the non-zero values were close to zero (e.g., 0.01) and likely reflected the sensitivity of using a 100mm scale. However, there were several cases where more substantial variability was noted (e.g., reporting .00 for FEEL and .30 for HIGH). In the current study, these aberrations did not impact the study results because the data were not included in the analyses. However, these types of discrepancies may not be as apparent in studies that have not linked the experience of all DEQ items to peak FEEL. Moving forward, researchers should review their data and decide prior to conducting statistical analyses how they wish to manage cases in which participants report feeling no drug effects and/or where discrepancies emerge (i.e. FEEL = 0; HIGH = 30).

**2. Examine the relationship among the DEQ items prior to conducting analyses or interpreting statistical findings to ensure the independence of the constructs:** The current study found support for considering each of the DEQ items as independent constructs. However, strong relationships were observed between items FEEL and HIGH and items LIKE and MORE across substances in the currents study. Based on the study findings, we recommend that researchers evaluate the strength of the relationships among items on a study-by-study basis to ensure that results are interpreted in a manner that accounts for potential nonindependence of items. For example, one would not want to interpret a common pattern of results observed for items LIKE, FEEL and HIGH as independent effects if the items were, in fact, indistinguishable.

### 3. Conduct future large-scale laboratory studies to assess SR to several different drugs, at different doses, in different users, with measures of concurrent and predictive validity to evaluate definitively the psychometric properties of DEQ-5

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## REFERENCES

Cole-Harding S, de Wit H. Self-administration of pentobarbital in light and moderate alcohol drinkers. Pharmacol Biochem Behav. 1992; 43:563–9. [PubMed: 1438493]

Comer SD, Sullivan MA, Walker EA. Comparison of intravenous buprenorphine and methadone self-administration by recently detoxified heroin-dependent individuals. J Pharmacol Exp Ther. 2005a; 315:1320–30. [PubMed: 16144974]

Comer SD, Walker EA, Collins ED. Buprenorphine/naloxone reduces the reinforcing and subjective effects of heroin in heroin-dependent volunteers. Psychopharmacology (Berl). 2005b; 181:664–75. [PubMed: 16025322]

Cox LS, Tiffany ST, Christen AG. Evaluation of the brief questionnaire of smoking urges (QSU-brief) in laboratory and clinical settings. Nicotine & Tobacco Research. 2001; 3:7–16. [PubMed: 11260806]

de Wit H, Phillips TJ. Do initial responses to drugs predict future use or abuse? Neurosci Biobehav Rev. 2012; 36:1565–76. [PubMed: 22542906]

Dlugos AM, Hamidovic A, Hodgkinson C, Shen PH, Goldman D, Palmer AA, de Wit H. OPRM1 gene variants modulate amphetamine-induced euphoria in humans. Genes Brain Behav. 2011; 10:199–209. [PubMed: 21029375]

Evans SM, Bisaga A. Acute interaction of baclofen in combination with alcohol in heavy social drinkers. Alcohol Clin Exp Res. 2009; 33:19–30. [PubMed: 18840257]

Evans SM, Levin FR. The effects of alprazolam and buspirone in light and moderate female social drinkers. Behav Pharmacol. 2002; 13:427–39. [PubMed: 12394419]

Evans SM, Levin FR, Fischman MW. Increased sensitivity to alprazolam in females with a paternal history of alcoholism. Psychopharmacology (Berl). 2000; 150:150–62. [PubMed: 10907668]

Fischman MW, Foltin RW. Utility of subjective-effects measurements in assessing abuse liability of drugs in humans. Br J Addict. 1991; 86:1563–70. [PubMed: 1786488]

Fischman MW, Schuster CR, Hatano Y. A comparison of the subjective and cardiovascular effects of cocaine and lidocaine in humans. Pharmacol Biochem Behav. 1983; 18:123–7. [PubMed: 6828530]

Folstein MF, Luria R. Reliability, validity, and clinical application of the Visual Analogue Mood Scale. Psychol Med. 1973; 3:479–86. [PubMed: 4762224]

Fraser HF, Van Horn GD, Martin WR, Wolbach AB, Isbell H. Methods for evaluating addiction liability. (A) "Attitude" of opiate addicts toward opiate-like drugs. (B) a short-term "direct" addiction test. J Pharmacol Exp Ther. 1961; 133:371–87. [PubMed: 13701509]

Hamidovic A, Childs E, Conrad M, King A, de Wit H. Stress-induced changes in mood and cortisol release predict mood effects of amphetamine. Drug Alcohol Depend. 2010; 109:175–80. [PubMed: 20176450]

Hamilton CM, Strader LC, Pratt JG, Maiese D, Hendershot T, Kwok RK, Hammond JA, Huggins W, Jackman D, Pan H, Nettles DS, Beaty TH, Farrer LA, Kraft P, Marazita ML, Ordovas JM, Pato CN, Spitz MR, Wagener D, Williams M, Junkins HA, Harlan WR, Ramos EM, Haines J. The PhenX Toolkit: get the most from your measures. Am J Epidemiol. 2011; 174:253–60. [PubMed: 21749974]

Harris DS, Baggott M, Mendelson JH, Mendelson JE, Jones RT. Subjective and hormonal effects of 3,4-methylenedioxymethamphetamine (MDMA) in humans. Psychopharmacology (Berl). 2002; 162:396–405. [PubMed: 12172693]

Johnson BA, Roache JD, Ait-Daoud N, Wallace C, Wells L, Dawes M, Wang Y. Effects of isradipine, a dihydropyridine-class calcium-channel antagonist, on d-methamphetamine's subjective and reinforcing effects. Int J Neuropsychopharmacol. 2005; 8:203–13. [PubMed: 15850499]

Jöreskog, KG.; Sörbom, D. LISREL 7: A guide to the program and applications. Chicago, IL: 1989.

King AC, de Wit H, McNamara PJ, Cao D. Rewarding, stimulant, and sedative alcohol responses and relationship to future binge drinking. Arch Gen Psychiatry. 2011; 68:389–99. [PubMed: 21464363]

Levitt A, Sher KJ, Bartholow BD. The Language of Intoxication: Preliminary Investigations. Alcoholism-Clinical and Experimental Research. 2009; 33:448–454.

Martin CS, Earleywine M, Musty RE, Perrine MW, Swift RM. Development and validation of the Biphasic Alcohol Effects Scale. Alcohol Clin Exp Res. 1993; 17:140–6. [PubMed: 8452195]

Martin WR, Sloan JW, Sapira JD, Jasinski DR. Physiologic, subjective, and behavioral effects of amphetamine, methamphetamine, ephedrine, phenmetrazine, and methylphenidate in man. Clin Pharmacol Ther. 1971; 12:245–58. [PubMed: 5554941]

McNair, DM.; Lorr, M.; Droppleman, LF. Profile of Mood States. Educational and Industrial Testing Service; San Diego, CA: 1971.

Meyers, LS.; Gamst, G.; Guarino, AJ. Applied multivariate research: Design and interpretation. Sage Publications; Thousand Oaks, CA: 2006.

Muthén, LK.; Muthén, BO. Mplus User's Guide. Muthén & Muthén; Los Angeles, CA: 1998-2008.

Phan KL, Angstadt M, Golden J, Onyewuenyi I, Popovska A, de Wit H. Cannabinoid modulation of amygdala reactivity to social signals of threat in humans. J Neurosci. 2008; 28:2313–9. [PubMed: 18322078]

Reed SC, Levin FR, Evans SM. Alcohol Increases Impulsivity and Abuse Liability in Heavy Drinking Women. Exp Clin Psychopharmacol. 2012

Saunders JB, Aasland OG, Babor TF, de la Fuente JR, et al. Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption: II. Addiction. 1993; 88:791–804. [PubMed: 8329970]

Sobell, LC.; Sobell, MB. Alcohol Consumption Measures. In: Allen, JP.; Wilson, VB., editors. Assessing alcohol problems : a guide for clinicians and researchers. 2003. p. 78-99.

U.S. Dept. of Health and Human Services, Public Health Service, National Institutes of Health, National Institute on Alcohol Abuse and Alcoholism; Bethesda, MD:

Sofuoglu M, Herman AI, Nadim H, Jatlow P. Rapid nicotine clearance is associated with greater reward and heart rate increases from intravenous nicotine. Neuropsychopharmacology. 2012; 37:1509–16. [PubMed: 22334123]

Toll BA, Katulak NA, McKee SA. Investigating the factor structure of the Questionnaire on Smoking Urges-Brief (QSU-Brief). Addict Behav. 2006; 31:1231–9. [PubMed: 16226843]

Wachtel SR, de Wit H. Naltrexone does not block the subjective effects of oral Delta(9)-tetrahydrocannabinol in humans. Drug Alcohol Depend. 2000; 59:251–60. [PubMed: 10812285]

Webster LR, Bath B, Medve RA, Marmon T, Stoddard GJ. Randomized, double-blind, placebo-controlled study of the abuse potential of different formulations of oral oxycodone. Pain Med. 2012; 13:790–801. [PubMed: 22568663]

Webster LR, Johnson FK, Stauffer J, Setnik B, Ciric S. Impact of intravenous naltrexone on intravenous morphine-induced high, drug liking, and euphoric effects in experienced, nondependent male opioid users. Drugs R D. 2011; 11:259–75. [PubMed: 21902287]

White TL, Justice AJ, de Wit H. Differential subjective effects of D-amphetamine by gender, hormone levels and menstrual cycle phase. Pharmacol Biochem Behav. 2002; 73:729–41. [PubMed: 12213517]

Zacny JP, Jun JM. Lack of sex differences to the subjective effects of nitrous oxide in healthy volunteers. Drug Alcohol Depend. 2010; 112:251–4. [PubMed: 20667429]

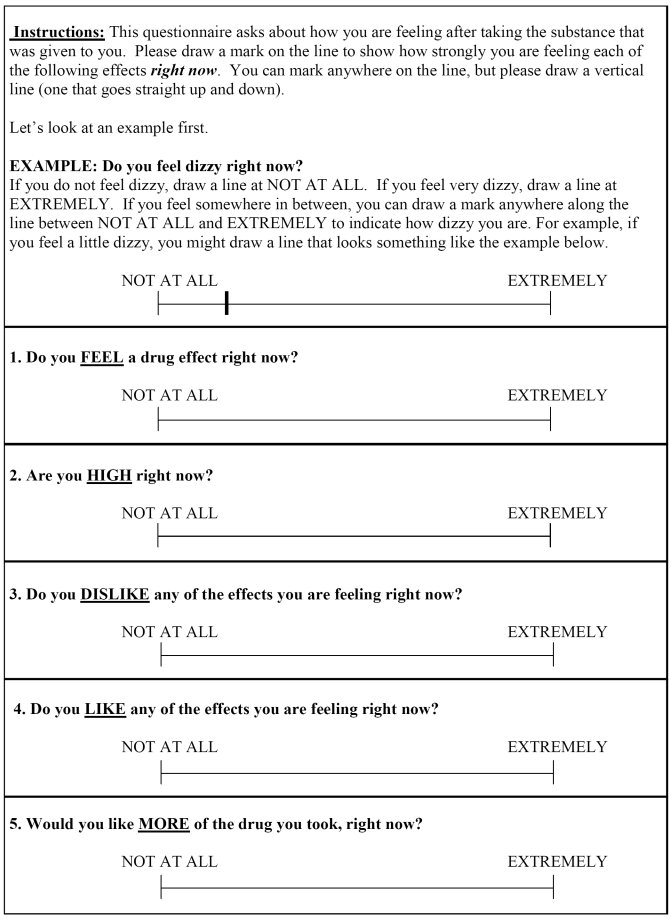


**Figure 1.**
The DEQ-5

## Table 1

DEQ Instructional Set, Item Wording, Response Anchors and Associated Descriptive Statistics of the Raw Data Listed by Substance

| | The 5-Item Version of the DEQ recommended for use by the PhenX Toolkit | | | | |
|---|---|---|---|---|---|
| **Instructional Set** | **You will be asked to indicate your answers to the following questions about the drug you consumed by marking on the line to indicate how much the adjective or description applies to you. Please indicate how you are feeling right now.** | | | | |
| Items | Do you FEEL a drug effect, right now? | Are you HIGH right now? | Do you DISLIKE any of the effects you are feeling right now? | Do you LIKE any of the effects you are feeling right now? | Would you like MORE of the drug you took, right now? |
| Response Anchors | "Not at all" to "Extremely" | "Not at all" to "Extremely" | "Not at all" to "Extremely" | "Not at all" to "Extremely" | "Not at all" to "Extremely" |

**The DEQ for AMPHETAMINE**

| **Instructional Set** | **Please indicate how you are feeling RIGHT NOW. Click the mouse on the white line at a position that corresponds to how much the adjective applies to you.** | | | | |
|---|---|---|---|---|---|
| Items | I FEEL some drug effects right now. | I am HIGH right now. | I DISLIKE the effects I am feeling right now.* | I LIKE the effects I am feeling right now. | I would like MORE of what I consumed right now. |
| Response Anchors | "Not at all" to "Very Strong Effect" | "Not at all" to "Very" | "Not at all" to "Dislike a lot" *OR Neutral to "Dislike a lot"* | "Not at all" to "Like a lot" *OR "Neutral" to "Like a lot"* | "Not at all" to "A lot" |
| Mean (SD) | .39(.27) | .27(.26) | .09(.16) | .46(.34) | 47(.34) |
| Median | 0.37 | 0.23 | 0.02 | 0.49 | 0.49 |
| Skewness | 0.30 | 0.76 | 2.70 | 0.08 | 0.02 |
| Std. Error Skew | 0.16 | 0.16 | 0.18 | 0.16 | 0.16 |
| Kurtosis | −0.96 | −0.36 | 8.34 | −1.24 | −1.22 |
| Std. Error Kurtosis | 0.31 | 0.31 | 0.36 | 0.31 | 0.31 |

**The DEQ for NICOTINE**

| **Instructional Set** | **Place a vertical line at the point on the scale which indicates how you feel about each of the statements right now.** | | | | |
|---|---|---|---|---|---|
| Items | I FEEL the drug effects. | I am HIGH. | I feel BAD drug effects.*[a] | I LIKE the drug effect. | I want MORE of the drug I took. |
| Response Anchors | "Not at all" to "Extremely" | "Not at all" to "Extremely" | "Not at all" to "Extremely" | "Not at all" to "Extremely" | "Not at all" to "Extremely" |
| Mean (SD) | .60(.30) | .46(.29) | .20(.23) | .42(.30) | .31(.29) |
| Median | 0.70 | 0.40 | 0.10 | 0.40 | 0.20 |
| Skewness | −0.29 | 0.21 | 2.02 | 0.33 | 0.87 |
| Std. Error Skew | 0.21 | 0.21 | 0.21 | 0.21 | 0.21 |
| Kurtosis | −1.27 | −1.14 | 4.00 | −1.22 | −0.30 |
| Std. Error Kurtosis | 0.41 | 0.41 | 0.41 | 0.41 | 0.41 |

**The DEQ for ALCOHOL**

| **Instructional Set** | **Version 1. Please indicate on the following lines how you are feeling right now. Make a mark ("click on the line" within the computerized version) corresponding to how much the adjective of description applies to you. Version 2. Click on the white line to indicate how much the word or phrase applies to how you are feeling right now.** | | | | |
|---|---|---|---|---|---|
| Items | Do you FEEL any drug effects right now? | Are you HIGH right now? | n/a | Do you LIKE the effects you are feeling right now? | Would you like MORE of what you consumed, right now? |
| Response Anchors | "Not at all" to "A lot" | "Not at all" to "Very" | | "Dislike" to "Like very much" | "Not at all" to "Very much" |
| Mean (SD) | .60(.26) | .44(.29) | -- | .57(.25) | .47(.31) |
| Median | 0.63 | 0.49 | -- | 0.58 | 0.52 |
| Skewness | −0.33 | −0.03 | -- | −0.50 | −0.17 |
| Std. Error Skew | 0.15 | 0.15 | -- | 0.15 | 0.15 |
| Kurtosis | −0.74 | −1.11 | -- | −1.18 | −0.10 |
| Std. Error Kurtosis | 0.28 | 0.28 | -- | 0.28 | 0.28 |

[*] *Note*. Denotes variables which were successfully log transformed to improve the distribution of the data.

[a] Superscript denotes that within the nicotine study, "I feel bad effects" was used in the absence of an item specifically assessing "DISLIKE."

## Table 2

Study Design, Inclusion Criteria, Sample Characteristics, and Measures of Interest Included across the Three Studies used to Evaluate the Psychometric Properties of the DEQ

| | Amphetamine | Nicotine | Alcohol |
|---|---|---|---|
| Study Design | * DEQ included as part of the assessment of acute subjective responses to oral d-amphetamine (0, 5, 10, 20 mg) in healthy young adults. | * DEQ included as part of a within-subject, single blind, laboratory challenge study examining responses to placebo, . 5mg., and 1mg of intravenously administered nicotine. | * DEQ included as part of a within-subject, double-blind, placebo-controlled laboratory challenge study examining acute subjective responses to placebo and alcohol (0.8 g/kg). |
| Description of Methodology | Dlugos et al., 2011 (N=162) | Sofuoglu et al., 2012 (N= 107) | King et al. 2011 (N = 190) |
| Inclusion Criteria | * age 18-35, BMI 19-25, some recreational drug use, normal EKG, physical exam, no psychiatric disorders, not working night shift, not pregnant, women not on oral contraceptives and only tested in follicular phase, fluent in English | *age 18-50, non-treatment seeking daily smokers (10-25 cigarettes per day) with an FTND score of at least 5 and CO level > 10ppm, otherwise in good general health with no current or past major medial or psychiatric disorders (including alcohol or other drug abuse), no current psychotropic medications, and not pregnant or breastfeeding | * age 21-35, BMI 19-30, good general health with no current or past major medical or psychiatric disorders (including alcohol and substance dependence), no current medications that would interact with study procedures , not pregnant * heavy drinking was defined as consuming 10-40 std. drinks weekly * regular binge drinking was defined as consuming ≥ 5 drinks on an occasion ( 4 for women) 1 to 5 times on average per week as the predominant adult pattern |
| Sample Characteristics | *247 college students & community participants | *146 community participants | *294 community participants |
| *Gender* | 50.60% male | 70.54 % male | 57.80% male |
| *Age* | 23.16(3.19) | 37.43(8.70) | 25.97(2.95) |
| *Ethnicity* | 100% Caucasian | 46.53% Caucasian 42.36% African American | 77.20% Caucasian |
| DEQ Version | * N=58 FEEL, HIGH, LIKE, MORE * N=189 FEEL, HIGH, DISLIKE, LIKE, MORE | *FEEL, HIGH, LIKE, MORE | *FEEL, HIGH, MORE, LIKE/ DISLIKE(BIPOLAR) |
| Additional Relevant Measures | * Lifetime Stimulant Use *Profile of Mood States | *Daily cigarette intake (total #) *Brief Questionnaire of Smoking Urges | *Quantity/Frequency of Alcohol Use *Biphasic Alcohol Effects Scale *Addiction Research Center Inventory *Alcohol Use Disorders Identification Test |

*Note*. LIKE/DISLIKE(BIPOLAR) denotes the use of a bipolar scale with anchors of “dislike very much”, “neutral,” and “like very much.”

## Table 3

The Ability of the DEQ Items to Differentiate Substance Effects from Placebo Effects and Dose Effects

| Substance (dose) | Active Substance versus Placebo<br>Effect Sizes (Cohen's D) | | | | |
|---|---|---|---|---|---|
| | **Feel Effects** | **Feel High** | **Dislike/Bad Effects** | **Like Effects** | **Want More Drug** |
| Amphetamine (10mg)[b] only unipolar | .47*** | .40*** | -.24** | .68*** | .53*** |
| Amphetamine (20mg)[a] only unipolar | 1.03*** | .93*** | -.24* | 1.27*** | 1.10*** |
| Nicotine[a] (.5mg) | 1.25*** | 1.02*** | .46*** | .85*** | .64*** |
| Nicotine (1mg) | 1.27*** | 1.19*** | .49*** | .70*** | .53*** |
| Alcohol[b] (peak BAC of .04g%) | 1.12*** | .72*** | -- | .36* | .34*** |
| Alcohol (peak BAC of .08g%) | 2.15*** | 1.56*** | -- | .56*** | .62*** |
| | **High vs. Low Dose** | | | | |
| Amphetamine (20mg vs. 10mg) | .56*** | .54*** | .01 | .54*** | .54*** |
| Nicotine (1mg vs. 0.5mg) | .05 | .14* | .02 | .06 | .10 |
| Alcohol (.80g/kg vs. .40g/kg) | 2.26*** | .87*** | -- | .45*** | .23*** |

*Note*. The table depicts the magnitude of paired-samples t-tests evaluating differences in each of the DEQ items by condition (i.e., placebo versus substance administration) as well as differences by dose.

[a]denotes that within the nicotine study, "I feel bad effects" was used in the absence of an item specifically assessing "DISLIKE."

[b]Superscript "b" denotes that within the alcohol study LIKE and DISLIKE were assessed using a single bipolar scale ranging from "dislike very much" to "like very much."

*p < .05

**p < .01

***p <.001

**Table 4**

Confirmatory Factor Analysis of the Drug Effects Questionnaire

| | | | Confirmatory Factor Analysis | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ***Model Fit Indices for Factor Comprising Feel, High, Like, More | | | | Modification Indices for Items Feel & High; Like & More | Item Loadings for Factor Comprising Feel, High, Like, More | | Inter-Item Correlations (All Items) | | | |
| DRUG | N | DOSE | CFI | TLI | RMSEA | SRMR | | DEQ ITEM | First Factor | HIGH | LIKE | MORE | DISLIKE |
| AMP | N = 243 | 20mg | 86 | .57 | .37 | .07 | 58.40 | FEEL | .76 | .80*** | .69*** | .62*** | .21** |
| | | | | | | | | HIGH | .70 | | .63*** | .57*** | .09 |
| | | | | | | | | LIKE | .99 | | | .90*** | -.12 |
| | | | | | | | | MORE | .91 | | | -- | -.12 |
| NICa | N = 146 | 1 mg | .82 | .47 | .29 | .09 | 23.86 | FEEL | .66 | .75*** | .66*** | .63*** | .45*** |
| | | | | | | | | HIGH | .55 | | .60*** | .49*** | .45*** |
| | | | | | | | | LIKE | .92 | | | .78*** | .24** |
| | | | | | | | | MORE | .83 | | | -- | .30*** |
| ALCb | N = 296 | .80 g/kg | .66 | .00 | .36 | .12 | 70.46 | FEEL | .29 | .57*** | .26*** | .14* | -- |
| | | | | | | | | HIGH | .41 | | .39*** | .23** | -- |
| | | | | | | | | LIKE | .96 | | | .68*** | -- |
| | | | | | | | | MORE | .74 | | | -- | -- |

*Note*. *For all substances except alcohol (for which DISLIKE was not explicitly assessed), DISLIKE was the only item on factor 1 and model fit was inherently "perfect" given that item loadings were set to 1. Therefore, the model fits for DISLIKE are not presented in the table. Superscript “a” denotes that within the nicotine study, “I feel bad effects” was used in the absence of an item specifically assessing “DISLIKE.” Superscript “b” denotes that within the alcohol study LIKE and DISLIKE were assessed using a single bipolar scale ranging from “dislike very much” to “like very much.” Abbreviations within the table are AMP = amphetamine; NIC = nicotine; ALC = alcohol; CFI = Bentler’s Comparative Fit Index; TLI = Tucker Lewis Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual.

* $p < .05$

** $p < .01$

*** $p < .001$

**Table 5**

Correlations of the DEQ with the Profile of Mood States, Addiction Research Center Index, and Biphasic Alcohol Effects Scale

| | | | Profile of Mood States | | | | | | | | Addiction Research Center Inventory | | | | | Biphasic Alcohol Effects Scale | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | FRIENDLY | ANXIOUS | DEPRESSED | FATIGUE | ANGER | ELATION | CONFUSION | VIGOR | AMPHETAMINE | BENZEDRINE | LSD | MORPHINE | PENTOBARBITAL | SEDATION | STIMULATION |
| AMP | 20 MG | Feel | .15** | .21*** | .08 | .07 | .15** | .29*** | .08 | .32*** | .53*** | .27*** | .32*** | .48*** | .01 | | |
| | | High | .17** | .18*** | .08 | −.05 | .11* | .34*** | .08 | .34*** | .55*** | .30*** | .32*** | .54*** | −.06 | | |
| | | Dislike | −.10 | .25*** | .32*** | .31*** | .35*** | −.19* | .38*** | −.16* | .08 | −.22** | .37*** | −.06 | .51*** | | |
| | | Like | .32*** | .04 | .03 | −.06 | .09 | .44*** | −.07 | .46*** | .55*** | .40*** | .05 | .58*** | −.17** | | |
| | | More | .26*** | .01 | −.02 | −.12* | .05 | .38*** | −.12* | .39*** | .53*** | .43*** | .05 | .57*** | −.24*** | | |
| ALCa | 0.80 g/kg | Feel | | | | | | | | | .22*** | .12* | .12* | .20*** | .11 | .44*** | .02 |
| | | High | | | | | | | | | .19** | .10 | .06 | .14* | .04 | .23*** | .27*** |
| | | Dislike | | | | | | | | | -- | -- | -- | -- | -- | -- | -- |
| | | Like | | | | | | | | | .18** | .13* | .03 | .18** | −.03 | −.22*** | .41*** |
| | | More | | | | | | | | | .20*** | .16** | .08 | .18** | −.10 | −.16** | .33*** |

*Note*. Superscript “a” denotes that within the alcohol study LIKE and DISLIKE were assessed using a single bipolar scale ranging from “dislike very much” to “like very much.”

* p < .05

** p < .01

*** p <.001

## Table 6

Hierarchical Regression Evaluating the Concurrent Validity of the DEQ Items for use with Amphetamine, Nicotine, and Alcohol

| | | AMPHETAMINE (20mg) | | | | NICOTINEa (1mg) | | | | ALCOHOLb (.08g%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Lifetime Stimulant Use | | | | Daily # Cigarettes Smoked | | | | Frequency of Alcohol Use (# Days in the Past Month) | | | | AUDIT (Past Month) | | | |
| | PREDICTORS | Δ $R^2$ | df | *F* | β | Δ $R^2$ | df | *F* | β | Δ $R^2$ | df | *F* | β | Δ $R^2$ | df | *F* | β |
| *STEP 1* | COVARIATES | .00 | (2, 236) | .27 | | .00 | (3, 135) | .54 | | .02* | (3, 290) | 3.44 | | .05*** | (3, 290) | 5.77 | |
| | SEX | | | | −.04 | | | | .00 | | | | −.04 | | | | −.15** |
| | RACE | | | | -- | | | | −.02 | | | | .08 | | | | .09 |
| | AGE | | | | .11 | | | | .11 | | | | −.16** | | | | −.15** |
| STEP(S) 2 | **DEQ ITEMS** | | | | | | | | | | | | | | | | |
| | FEEL | .02** | (1, 235) | 6.30 | .16 | .00 | (1, 134) | .23 | −.04 | .04*** | (1, 289) | 11.77 | −.20 | .08*** | (1, 289) | 27.97 | −.29 |
| | HIGH | .03*** | (1, 235) | 9.39 | .20 | .00 | (1, 134) | .07 | −.02 | .00 | (1, 289) | 2.05 | −.08 | .04*** | (1, 289) | 12.68 | −.20 |
| | DISLIKE .01 | (1, 181) | 3.47 | −.14 | .00 | (1, 134) | .41 | .06 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | LIKE | .04*** | (1, 235) | 13.11 | .23 | .02* | (1, 134) | 5.24 | −.19 | .05*** | (1, 289) | 17.74 | .24 | .05*** | (1, 289) | 17.20 | .24 |
| | MORE | .01* | (1, 235) | 4.76 | .14 | .02* | (1, 134) | 4.23 | −.18 | .06*** | (1, 289) | 20.67 | .26 | .14*** | (1, 289) | 51.85 | .39 |

Note. Within the amphetamine study, lifetime stimulant use was used to evaluate the concurrent validity of the DEQ items. Within the nicotine study, the average number of cigarettes smoked per day was used to evaluate concurrent validity of the DEQ items. Within the alcohol study, the number of days participants consumed alcohol in the past month and AUDIT scores over the past month were used to evaluate concurrent validity of the DEQ items. Separate models were run for each DEQ item. Step 1 included sex, race, and age as covariates. Step 1 of the nicotine and alcohol regression models included sex, race, and age as covariates. The model for amphetamine did not include race because all participants were Caucasian. Step 1 results are presented only once (highlighted in gray) for each substance. Results from Steps 2 of each model are then presented. The significance levels depicted in the table do not reflect any corrections for multiple comparisons. However, all significant findings remained statistically significant after we employed false discovery rate (FDR) with a tolerance level for Type I error set to alpha = .05 with the exception of the results for nicotine (denoted in italicized font). Superscript “a” denotes that within the nicotine study, “I feel bad effects” was used in the absence of an item specifically assessing “DISLIKE.” Superscript “b” denotes that within the alcohol study LIKE and DISLIKE were assessed using a single bipolar scale ranging from “dislike very much” to “like very much.”

* p < .05

** p < .01

*** p <.001

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**Table 7**

Hierarchical Regression Evaluating the Predictive Validity of the DEQ Items for use with Nicotine and Alcohol

| | | NICOTINEa (1 mg) | | | | | | | | ALCOHOLb (.08g%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Urge to Smoke After Nicotine Administration | | | | | | | | Year 2 Follow-Up | | | | | | | |
| | | Global Desire | | | | Negative Affect Relief | | | | Frequency of Alcohol Use (# Days in the Past Month) | | | | Alcohol-Related Problems | | | |
| | **PREDICTORS** | **$\Delta R^2$** | **df** | **F** | **β** | **$\Delta R^2$** | **df** | **F** | **β** | **$\Delta R^2$** | **df** | **F** | **β** | **$\Delta R^2$** | **df** | **F** | **β** |
| **STEP 1** | **COVARIATES** | .19*** | (5, 131) | 7.29 | | .47*** | (5, 134) | 25.91 | | .05*** | (3, 186) | 9.16 | | .08*** | (3, 186) | 6.31 | |
| | SEX | | | | .05 | | | | −.01 | | | | −.07 | | | | −.14* |
| | RACE | | | | .09 | | | | .06 | | | | .24*** | | | | .22** |
| | AGE | | | | −.01 | | | | .01 | | | | .07 | | | | −.14*** |
| | SMOKE URGE (*General*) | | | | .48*** | | | | .05 | | | | -- | | | | -- |
| | SMOKE URGE (*Neg. Affect*) | | | | −.06 | | | | .66*** | | | | -- | | | | -- |
| **STEP(S) 2** | **DEQ ITEMS** | | | | | | | | | | | | | | | | |
| | FEEL | .04** | (1, 130) | 7.64 | −.22 | .02* | (1, 133) | 6.42 | −.16 | .06*** | (1, 185) | 13.69 | −.24 | .07*** | (1, 185) | 15.58 | −.27 |
| | HIGH | .08*** | (1, 130) | 14.85 | −.30 | .04*** | (1, 133) | 12.34 | −.22 | .01 | (1, 185) | 2.45 | −.11 | .00 | (1, 185) | 1.42 | −.08 |
| | DISLIKE | .08*** | (1, 130) | 14.78 | .30 | .03** | (1, 133) | 8.90 | .19 | -- | -- | -- | -- | -- | -- | -- | -- |
| | LIKE | .01 | (1, 130) | 2.77 | −.15 | .00 | (1, 133) | .69 | −.06 | .03* | (1, 185) | 5.59 | .17 | .07*** | (1, 185) | 16.15 | .28 |
| | MORE | .02* | (1, 130) | 3.67 | −.16 | .02* | (1, 133) | 4.90 | −.15 | .04** | (1, 185) | 9.68 | .22 | .14*** | (1, 185) | 34.09 | .39 |

*Note*. For nicotine, outcomes used to evaluate predictive validity included participants' self-reported smoking urges at the end of the nicotine administration paradigm (i.e., after the .5mg and 1mg doses had been administered). For alcohol, outcomes used to evaluate predictive validity included the average number of days per month than participants consumed alcohol over the course of the two-year study follow-up period as well as AUDIT scores at the 2-year follow-up. Separate models were run for each DEQ item. Step 1 included sex, race, and age as covariates. For the nicotine models, baseline smoking urges were included as additional covariates due to their significant relationship with the predictor and or criterion variables across the models. Step 1 results are presented only once (highlighted in gray) for each substance. Results from Steps 2 of each model are then presented. The significance levels depicted in the table do not reflect any corrections for multiple comparisons. However, all significant findings remained statistically significant after we employed false discovery rate (FDR) with a tolerance level for Type I error set to alpha = .05 with the exception of the results for MORE after nicotine administration (denoted in italicized font). Superscript "a" denotes that within the nicotine study, "I feel bad effects" was used in the absence of an item specifically assessing "DISLIKE." Superscript "b" denotes that within the alcohol study LIKE and DISLIKE were assessed using a single bipolar scale ranging from "dislike very much" to "like very much."

* p < .05

** p < .01

*** p <.001