Published in final edited form as:

Drug Alcohol Depend. 2014 March 1; 136: 121–126. doi:10.1016/j.drugalcdep.2013.12.020.

Comparison of categorical alcohol dependence versus a dimensional measure for predicting weekly alcohol use in heavy drinkers

Tera L. Fazzino^{a,b,*}, Gail L. Rose^b, Keith B. Burt^a, and John E. Helzer^b

Tera L. Fazzino: tfazzino@uvm.edu

^aDepartment of Psychology, University of Vermont, 2 Colchester Avenue, Burlington, VT 05401, USA

^bDepartment of Psychiatry, University of Vermont, 1 South Prospect Street, Burlington, VT05401, USA

Abstract

Background—The DSM specifies categorical criteria for psychiatric disorders. In contrast, a dimensional approach considers variability in symptom severity and can significantly improve statistical power. The current study tested whether a categorical, DSM-defined diagnosis of Alcohol Dependence (AD) was a better fit than a dimensional dependence measure for predicting change in alcohol consumption among heavy drinkers following a brief alcohol intervention (BI). DSM-IV and DSM-5 alcohol use disorder (AUD) measures were also evaluated.

Methods—Participants ($N = 246$) underwent a diagnostic interview after receiving a BI, then reported daily alcohol consumption using an Interactive Voice Response system. Dimensional AD was calculated by summing the dependence criteria (mean = 4.0; SD = 1.8). The dimensional AUD measure was a summation of positive Alcohol Abuse plus AD criteria (mean = 5.8; SD = 2.5). A multi-model inference technique was used to determine whether the DSM-IV categorical diagnosis or dimensional approach would provide a more accurate prediction of first week consumption and change in weekly alcohol consumption following a BI.

Results—The Akaike information criterion (AIC) for the dimensional AD model (AIC = 7625.09) was 3.42 points lower than the categorical model (AIC = 7628.51) and weight of evidence calculations indicated there was 85% likelihood that the dimensional model was the better approximating model. Dimensional AUD models fit similarly to the dimensional AD model. All AUD models significantly predicted change in alcohol consumption (p 's = .05).

© 2014 Elsevier Ireland Ltd. All rights reserved.

*Corresponding author at: Health Behavior Research Center, Department of Psychiatry, University of Vermont, UHC Campus 457OH3, 1 South Prospect Street, Burlington, VT 05401, USA. Tel.: +1 802 847 1441.

Contributors: Authors Dr. Rose and Dr. Helzer designed and conducted the parent study from which the data for this secondary analysis were derived. Ms. Fazzino managed the literature searches and summaries of previous related work. Ms. Fazzino and Dr. Burt undertook the statistical analysis. Ms. Fazzino wrote the first draft of the manuscript and all authors contributed to revisions and the final version of the manuscript. All authors have approved the final manuscript.

Conflict of interest: No conflict declared.

Conclusion—A dimensional AUD diagnosis was superior for detecting treatment effects that were not apparent with categorical and dimensional AD models.

Keywords

Dimensional; Alcohol use disorder; Multi-model inference; Diagnosis; DSM-IV; DSM-5

1. Introduction

Categorical diagnoses of psychiatric disorders based on explicit criteria have been utilized since the publication of the Diagnostic and Statistical Manual for Mental Disorders III (DSM-III; American Psychiatric Association, 1980). With categorical constructs, diagnostic decisions are a binary choice: an individual is deemed to either have a disorder or not. For years, this has been the *de facto* gold standard in the field of mental health (Helzer et al., 2009). However, when Edwards and Gross published their theory of alcohol dependence in 1976, they conceptualized alcohol dependence as a dimensional construct. Specifically, they proposed that alcohol dependence occurs to varying degrees of severity in individuals and that such variability should be considered diagnostically and clinically (Edwards and Gross, 1976).

A dimensional measure of alcohol dependence better reflects this conceptualization and has several advantages over a categorical approach. First, a dimensional diagnosis considers variability in severity of alcohol dependence. For example, a dimensional measure that counts the number of alcohol criteria an individual meets provides information about diversity in symptom presentation and is valuable for both clinical and research purposes (Hasin et al., 2006; Helzer et al., 2006a,b). In addition, since it is a quantitative measure, a dimensional diagnosis of alcohol dependence can improve statistical power; the high statistical costs of dichotomizing a quantitative variable have previously been demonstrated (Cohen, 1983; MacCallum et al., 2002). This point is particularly important in human subjects research, where achieving an adequate sample size for valid statistical analysis can be challenging. A dimensional approach is also helpful to clinicians since denoting severity can be a significant aid in communicating clinical status, evaluating research reports, and treatment planning. However, the two Alcohol Use Disorders (AUD) in the DSM-IV, i.e., Alcohol Abuse (AA) and Alcohol Dependence (AD), are both defined categorically (American Psychiatric Association, 1994). Since the publication of DSM-IV, several researchers have suggested using a dimensional diagnosis for both clinical and research purposes (Meyer, 2001; Hasin et al., 2006, 2003; Muthén, 2006; Helzer et al., 2006a,b) and adding a dimensional option to the fifth edition of the DSM (DSM-5; American Psychiatric Association, 2013; Tarter et al., 1992; Helzer et al., 2006a,b).

Research to date on DSM-IV provides support for a dimensional diagnostic approach. Dawson et al. (2010) constructed a dimensional measure of AUD that includes criteria for both AA and AD, and demonstrated its validity for predicting alcohol consumption in a cross sectional sample. In addition, a dimensional AUD measure, compared to the standard categorical AD diagnosis has been found to have a stronger correlation with risk factors for AUDs, including family history of alcoholism and early drinking onset (Hasin and Beseler, 2009). Further, Dawson et al. (2010) determined that a simple count of DSM-IV abuse and

dependence criteria endorsed is as proficient a predictor of alcohol use as weighted criteria based on symptom severity.

The DSM-5 has combined the DSM-IV AA and AD criteria, removed the legal criterion, and added a craving criterion, as suggested by research. However, in spite of evidence supporting the dimensional diagnostic approach, the recently published DSM-5 has retained a categorical AUD diagnosis of dependent/not dependent. Two or more symptoms constitute a diagnosis of dependence. The DSM-5 now offers a quasi-dimensional severity scale based on tri-categorization of the positive symptom count; 2–3 symptoms are considered mild dependence, 4–5 symptoms are considered moderate, and 6 or more are considered severe (American Psychiatric Association, 2013). Thus, categorical distinctions have been retained for both AUD diagnosis and the dependence severity measure. Although not advocated in DSM-5, a fully dimensional approach could be constructed using a simple count of the number of symptoms endorsed.

In this report, we compare a fully dimensional AD measure to the dichotomous dependence diagnosis. To our knowledge, a direct comparison of this type has not previously been reported. Specifically, we tested whether a dimensional or a categorical AD diagnosis was a better fit to the data for predicting alcohol consumption the first week following a BI and change in weekly alcohol consumption over the subsequent four weeks. We also evaluated a dimensional AUD scale that incorporated both AA and AD DSM-IV criteria. We included this measure because in the DSM-5, AA and AD criteria were combined to constitute an AUD (however the diagnostic determination is still made categorically, in contrast to our dimensional model). Additionally, this dimensional measure has been previously evaluated in the literature (Dawson et al., 2010; Hasin and Beseler, 2009). As a secondary analysis we evaluated the predictive ability of three dimensional AUD models that were constructed using DSM-5 criteria. We included the DSM-5 criteria to evaluate model fit within the current DSM-5 diagnostic system.

2. Methods

Data for the current manuscript were obtained from a study that evaluated the use of Interactive Voice Response (IVR) as a self-monitoring tool for 6 months following a BI for alcohol use in primary care (Helzer et al., 2008). The main objective of the original study was to determine if six months of IVR self-monitoring with or without monthly feedback about alcohol use would produce a greater reduction in alcohol consumption compared to no self-monitoring.

2.1. Participants

Participants were recruited from 15 primary care offices in the Burlington, Vermont metropolitan area. Primary care providers screened their patients for heavy alcohol use and conducted a BI when appropriate. Patients who received a BI and were willing to participate in the study were referred to the research staff. Participants were included in the study if they reported recent (past 3 month) alcohol consumption beyond the NIAAA guidelines for low risk drinking: 1) average daily or weekly alcohol use exceeding 2 drinks per day/14 per week for men or 1 per day/7 per week for women, or 2) 5 or more drinks in a day for men or

4 for women (National Institute on Alcohol Abuse and Alcoholism, 2005). Both dependent and non-dependent individuals as defined by DSM-IV categorical criteria were included. Exclusion criteria were current (past year) DSM-IV diagnosis of substance dependence other than alcohol, nicotine, or marijuana; a current diagnosis of psychosis; or a recent initiation or change in antidepressant medication.

2.2. Procedure

Research personnel contacted each study referral by telephone and scheduled an in-person informed consent and assessment at our research office. Detailed study procedures and the full assessment battery were presented previously (Helzer et al., 2008). Briefly, consenting participants received a 20 min training session during which they were instructed on reporting standard drink volumes and oriented to using the IVR. Participants were provided a toll-free, 24 h access phone number to contact the IVR and were asked to call daily for 6 months (180 days). The IVR call was a 2-min questionnaire that assessed alcohol consumption (number of standard servings of beer, liquor, and wine assessed separately), craving intensity, reasons for drinking/abstaining, and questions about psychological and physical health. All questions inquired about the previous 24 h (“yesterday”) to ensure a consistent reporting period.

2.3. Predictor variables

Symptoms of AD were assessed with the Composite International Diagnostic Interview-Substance Abuse Module for DSM-IV (CIDI-SAM; Cottler et al., 1989). A categorical AD diagnosis was based on DSM-IV diagnostic criteria (American Psychiatric Association, 1994).

The DSM-IV dimensional AD diagnosis was determined by counting the number of dependence criteria (0–7) met in the past 12 months. DSM-IV defined dependence symptoms included: (1) tolerance, (2) withdrawal, (3) substance taken in larger amounts/longer period than intended, (4) persistent desire or unsuccessful attempts to decrease/control use, (5) great deal of time spent obtaining, using or recovering from effects of alcohol, (6) social, occupational, or recreational activities given up or reduced because of use, (7) use despite knowledge of physical or psychological problems caused or exacerbated by use. The DSM-IV dimensional AUD diagnosis was determined by counting the number of abuse criteria (0–4; (1) recurrent failure to fulfill major role obligations, (2) recurrent use in hazardous situations, (3) recurrent legal problems due to use, (4) continued use despite social/interpersonal problems) and dependence criteria (0–7) participants endorsed within the past 12 months, with a possible range between 0 and 11.

The 11 AUD symptoms specified in the DSM-5 consist of the aforementioned DSM-IV abuse and dependence symptoms, without the legal problems criterion and with an added craving/strong urge to drink criterion. The craving criterion was approximated because the CIDI-SAM version used in the study did not assess craving. We determined the presence of craving from the first IVR report that participants made the day after they completed their diagnostic interview. We reasoned that if a participant reported craving in the first IVR

report, they likely would have reported craving during the diagnostic interview the previous day.

Craving was operationalized in two different ways, which resulted in three variations of the craving criterion used in three separate analyses. In one model, we conceptualized the craving criterion as any non-zero craving report. In two additional models, we conceptualized the craving criterion as the mean daily craving rating for the sample. Mean craving rating for days in the study ranged from 3.1 to 4.3. Thus, in separate analyses we included one dimensional variable with a craving criterion based on craving ratings of 3 or higher and another dimensional variable with ratings of 4 or higher. Craving was assessed with the following prompt: “Rate your urge to drink yesterday on a scale of 0 to 9, with 0 being no urge to drink and 9 being the strongest urge ever to drink.”

2.4. Outcome variable

Total number of drinks was assessed with the following prompt using a separate question for each type of alcohol: “How many [beers/drinks containing liquor/glasses of wine] did you have yesterday?” Validity of previous day alcohol consumption reported via the IVR has previously been demonstrated (Searles et al., 1995). Total weekly alcoholic drinks were computed by summing the total number of alcoholic drinks reported to the IVR in each 7 day period. First week total alcohol consumption was operationalized as the total number of alcoholic drinks consumed in the first study week (used as the model intercept), and longitudinal alcohol consumption was modeled as the change in total drinks per week (used as the model slope).

While participants in the parent study reported alcohol use for 6 months, analyses for the current study were restricted to the first month, because the parent study observed the strongest treatment effects in the first month following the BI (Helzer et al., 2008), consistent with other BI efficacy studies in the literature (Moyer et al., 2002). Restricting our time points to four also allowed us to evaluate a timeframe that was appropriate for the data analytic technique used (see Section 2.7).

2.5. Data analysis

Standard null-hypothesis significance testing was not the primary method of analysis used in the study, as binary significant/not significant estimates for prediction do not evaluate model fit, and use an arbitrary .05 cut point to determine significance (Cowles and Davis, 1982). Multi-model inference techniques allowed us to more comprehensively evaluate the likelihood of superior model fit with the data. However, we have included standard model coefficients to consider whether the predictor variables were meaningful predictors of alcohol use beyond chance. In the next two sections we first describe the models used in the analyses, followed by a description of the multi-model inference technique.

2.6. Linear mixed models description

Linear modeling using generalized least squares (GLS) to account for correlated observations was used to build six different models with diagnosis (categorical or dimensional) predicting total drinks per week. Analyses were conducted in R (R

Development Core Team, 2012) with the *gls()* function from the *nlme* package (Pinheiro et al., 2012) utilizing a longitudinal data environment which allows clustering by participant identification number and sorting by study week from 1 through 4. For longitudinal analyses, reports from the same individual over time will be correlated (Long, 2011). The GLS analytic technique was chosen because this technique accounts for within-subject report correlation.

We explored several potential within-ID correlation structures (exchangeable, unstructured, autoregressive) and determined that an autoregressive correlation structure fit the data best based on Akaike's Information Criterion (AIC; Akaike, 1973, 1974) and weight of evidence estimates. Therefore, all models assumed an autoregressive correlation structure.

Three GLS models were specified to evaluate whether a DSM-IV categorical or dimensional diagnosis was a better fit to the data in predicting first week alcohol consumption (intercept) and change in alcohol consumption per week over four weeks (slope). The categorical model (A1) was constructed with a categorical AD diagnosis (dependent/not dependent) predicting total drinks consumed the first study week and change in weekly total drinks consumed. Two separate DSM-IV dimensional models were constructed with dimensional diagnosis (either AD (model A2) or AUD (model A3)) predicting the outcome variable.

Three DSM-5 models were constructed in the same way as the DSM-IV dimensional models. The distinction between the three DSM-5 models was based on our conceptualization of the craving criterion. The first DSM-5 model (B1) operationalized craving as any non-zero craving rating. The second DSM-5 model (B2) operationalized craving as any craving rating of 3 or higher and the third (B3) dimensional model included a craving criterion based on any rating of 4 or higher. For a summary of the predictor variables used in all models, please see Table 1.

2.7. Multi-model inference technique description

A multi-model inference technique was used to compare which model was a better fit to the data using maximum likelihood estimation (MLE). MLE uses a likelihood function which is a transformation of the deviance function to determine the rank ordered likelihood that each model is the best fitting model based on the observed data (Long, 2011). The better fitting model using MLE was determined with two sets of criteria: comparing the AIC estimates of the DSM-IV categorical and dimensional models; and comparing weight of evidence estimates for the two models. AIC is a measure of predictive accuracy with a deviance penalization for the number of estimated parameters in a model; a lower AIC is considered a better fit to the data (Long, 2011) and the magnitude of the difference between the AIC values of each model, or delta, can be used to determine the extent that the models differ. While no precise cutoff points have been specified, differences between 0 and 2 are generally considered minimal, differences of 4–7 are generally considered moderate to strong, and differences of 8–10 or above are generally considered very strong (Burnham and Anderson, 2002). Weight of evidence estimates provide information about the probability that a particular model is the best approximating model to the data based on a specific set of models, and provides this estimate for each model out of 100% (Long, 2011). For the DSM-IVAUD model, we compared the AIC values from this model to the dimensional AD

model's AIC. For all analyses, missing data were treated as missing at random and maximum likelihood estimation methods were employed that make use of all available data for each participant.

3. Results

3.1. Participant information

The final study sample included 246 participants (166 men, 80 women) with mean age of 45.7 years ($SD = 12.8$, $range = 21-82$). Ninety-seven percent of participants were Caucasian/non-Hispanic, 76% reported being employed full time, and had completed a mean of 15 years of education. Sixteen percent of participants reported being prescribed antidepressant medication at baseline.

3.2. Descriptive statistics

Sixty-six percent of participants met criteria for a categorical DSM-IV diagnosis of AD at baseline. The mean number of symptoms met was 4.0 ($SD = 1.8$) for the DSM-IV dimensional AD measure and 5.8 ($SD = 2.5$) for the DSM-IV dimensional AUD measure. The mean number of symptoms met for the dimensional DSM-5 B1 model was 6.7 ($SD = 2.4$), 6.7 ($SD = 2.5$) for the dimensional B2 model, and 6.4 ($SD = 2.5$) for the dimensional B3 model. Participants drank on 94% of the four study weeks and the mean number of drinks per week across the study was 26.5 ($SD = 5.3$, $range = 0-155$).

3.3. IVR compliance

Participants completed a mean of 93% of scheduled calls and a median of 100% over the four study weeks. Collectively, participants completed a total of 6188 IVR reports for the four weeks.

3.4. Multi-model inference

Based on Burnham and Anderson's (2002) criteria for delta AIC values, there was moderate to strong evidence that the dimensional DSM-IV AD model (A2) was a better fit for predicting alcohol use compared to the categorical diagnosis model (A1) (Table 2). The weight of evidence estimate (Long, 2011) for the dimensional AD model was 85%, indicating that the dimensional model was the better fitting model compared to the categorical model ($A2 = 0.85$). Weight of evidence for the categorical model was 15%, indicating low support for the categorical model being the better fit ($A1 = 0.15$).

The fits of the DSM-IV and DSM-5 dimensional AUD models were as good as the dimensional AD model (Table 2). A direct comparison of a DSM-5 dimensional diagnosis with a categorical diagnosis was not possible because 98% met DSM-5 criteria for an AUD.

3.5. Model coefficients

For DSM-IV criteria, both the dimensional and categorical diagnosis variables significantly predicted first week alcohol use; however, the relationship was stronger in the dimensional models (Table 3). The dimensional AD model-predicted number of drinks consumed the

first week was 22.74 for participants with 0 symptoms of dependence, with 2.04 additional drinks for each additional symptom endorsed.

All of the dimensional AUD models significantly predicted change in weekly alcohol consumption over four weeks (Tables 3 and 4). The DSM-IV dimensional model-predicted change was 0.64 fewer drinks per week for participants with 0 symptoms, with an additional 0.28 drink decrease per week per additional symptom. Thus, the decrease in alcohol consumption was more prominent for participants with higher dimensional diagnosis scores compared to those with lower dimensional scores. Results were similar for the DSM-5 dimensional model B1 and slightly better for the models B2 and B3 (Table 3).

4. Discussion

The purpose of the current study was to evaluate whether a dimensional or categorical definition of AD better predicted alcohol consumption in the first month following a physician-delivered BI. Results indicated that a dimensional approach was superior compared to a DSM-IV categorical diagnosis. The DSM-IV and DSM-5 dimensional AUD models performed similarly to the DSM-IV dimensional dependence model. Our findings are consistent with the original theory of alcohol dependence as proposed by Edwards and Gross (1976), that alcohol dependence is best conceptualized as a dimensional phenomenon. Our results are also consistent with findings in the literature that support the use of a dimensional AUD diagnosis for evaluating alcohol use and risk factors for AUDs (Dawson et al., 2010; Hasin and Beseler, 2009). Our findings extend the current literature, as we specifically compared dimensional and categorical models and evaluated DSM-5 criteria in a treatment context. A dimensional diagnosis may have been a better fit to the data because a dimensional scale considers variability in severity of dependence (Hasin and Beseler, 2009; Helzer et al., 2006a,b), and also improves statistical power (Cohen, 1983).

It is important to note that based on the model-fitting technique used above, it is not a foregone conclusion that the dimensional model would provide a better fit for the data simply due to having a larger range of values. Indeed, if the variability within each criterion in the dimensional variable was not meaningfully related to alcohol consumption, the categorical model would be more parsimonious and thus would have been identified as providing the better fit to the data. This is because AIC penalizes for estimation of additional model parameters, meaning that for models that are equivalent representations of data, the simpler or more parsimonious model will obtain a smaller, more desirable AIC value.

Results indicated that the AUD dimensional models for both taxonomies predicted a significant change in weekly alcohol consumption over the four weeks following a BI, while the categorical model did not. Although the DSM-IV dimensional AD model did miss the .05 significance cut off, the model fit was the same as the DSM-IV dimensional AUD model, and it came closer to detecting these effects compared to the categorical model ($p = .08$ vs. .56). Our results exemplify one high cost of dichotomization (Cohen, 1983; MacCallum et al., 2002). Similar results pertained to two molecular genetics studies in which the researchers did not find a significant relationship between categorical DSM-IV AD and polymorphism ADH1B in the alcohol dehydrogenase gene, but did find a significant

relationship between the two when analyzed with a dimensional scale (Hasin et al., 2002; Heath et al., 2001).

While the current study evaluated a continuous dependent variable (change in alcohol use over time), it should be noted that BI studies also evaluate treatment effects via a dichotomous dependent variable; i.e., whether participants exceeded NIAAA guidelines post-intervention. By considering how variability in symptom presentation relates to alcohol consumption, a dimensional dependence measure is likely to improve outcome prediction, even when the outcome is dichotomous.

There were several limitations to the current study. First, we approximated the DSM-5 craving diagnostic criterion because the DSM-IV diagnostic interview conducted at the time of data collection did not evaluate craving. We used the first craving report participants made to the IVR (which was completed the day after the diagnostic interview) as a proxy for the craving criterion. We recognize that our single day measure of craving is an imperfect substitution for the DSM-5 craving criterion. For this reason, we evaluated three variations of our craving criterion and results were very similar in the three models.

Another limitation is that we were not able to directly compare DSM-5 dimensional criteria to DSM-5 categorical criteria because 98% of the sample met DSM-5 criteria for an AUD (as opposed to 66% for DSM-IV categorical criteria). However, the majority of the DSM-IV and DSM-5 criteria are identical in both of the taxonomies. The DSM-IV and DSM-5 dimensional models performed very similarly and it is likely that a direct comparison of DSM-5 dimensional and categorical diagnoses would yield similar results to the DSM-IV dimensional-categorical comparison.

The current study had several strengths, including a large sample size and a nearly complete set of daily process data on alcohol consumption. In addition, the dimensional symptoms were normally distributed in our sample, which allowed our models to consider the full range of variability in diagnostic severity. Also, we collected self-report data via IVR. Kobak et al. (1997) demonstrated that respondents tend to report more alcohol use to an IVR than to a live interviewer. We did use MLE to account for the small amount of missing data, but since our call compliance was so high it was not necessary to use data imputation.

Our analyses extended beyond the standard null hypothesis significance testing to evaluate goodness-of-fit for our models using multi-model inference technique. Just as a dimensional diagnosis considers variability in the data and allows for a more nuanced examination of the relationship between diagnosis and associated variables, the multi-model inference technique allowed us to more precisely evaluate (on a scale from 0 to 100%) which of two models is a better fit to the data, compared to the standard binary significant/not significant testing.

Future research could extend our evaluations of dimensional and categorical measures by examining model fit in samples with different levels of variance in alcohol use. Fit may depend on whether variance in a sample is continuous or more discrete, however this has not been investigated in the literature. Such an evaluation could further contribute to our understanding of the predictive properties of dimensional and categorical measures.

Other treatment studies may benefit from the analysis of treatment response with a dimensionally defined AUD diagnosis. Additionally, researchers could examine how dimensionally conceptualized AUD relates to other outcome variables such as relapse rates, drug use and other comorbidities, and the long-term natural history of alcohol dependence. Expanding analyses to incorporate dimensional AUD allows for the statistical consideration of variability in AUD symptomology and may improve understanding of the nuances of how an AUD relates to alcohol use and associated variables. A dimensional approach may also be useful to clinicians for professional communication and treatment planning.

Acknowledgments

Role of funding source: The study was funded by the National Institute on Alcohol Abuse and Alcoholism (R01-AA11954, Dr. Helzer, PI). NIAAA grant R01AA018658 (Dr. Rose, PI) supported the following researchers' time during manuscript preparation: Ms. Fazzino, Dr. Rose, and Dr. Helzer. Dr. Burt's time was supported by Psychology Department funds at the University of Vermont. The NIAAA had no further role in study design; in the collection, analysis and interpretation of data; in the writing of the report; or in the decision to submit the paper for publication.

References

- Akaike H. A new look at the statistical model identification. *IEEE Trans Autom Control*. 1974; 19:716–723. <http://dx.doi.org/10.1109/TAC.1974.1100705>.
- Akaike, H. Information theory and an extension of the maximum likelihood principle. In: Parzen, E.; Tanabe, K.; Kitagawa, G., editors. *Selected Papers of Hirotugu Akaike*. Springer; New York: 1973. p. 199–213.
- American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*. third. American Psychiatric Association; Washington, DC: 1980. DSM-III.
- American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders: DSM-IV*. American Psychiatric Association; Washington, DC: 1994.
- American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders (DSM-5)*. fifth. American Psychiatric Association; Washington, DC: 2013.
- Burnham, KP.; Anderson, DR. *Model Selection and Multi-Model Inference: A Practical Information-Theoretic Approach*. 2nd. Springer; New York: 2002.
- Cohen J. The cost of dichotomization. *Appl Psychol Meas*. 1983; 7:249–253.
- Cottler LB, Robins LN, Helzer JE. The reliability of the CIDI-SAM: a comprehensive substance abuse interview. *Br J Addict*. 1989; 84:801–814. [PubMed: 2758153]
- Cowles M, Davis C. On the origins of the .05 level of statistical significance. *Am Psychol*. 1982; 37:553–558.
- Dawson DA, Saha TD, Grant BF. A multidimensional assessment of the validity and utility of alcohol use disorder severity as determined by item response theory models. *Drug Alcohol Depend*. 2010; 107:31–38. [PubMed: 19782481]
- Edwards G, Gross MM. Alcohol dependence: provisional description of a clinical syndrome. *Br Med J*. 1976; 1:1058–1061. [PubMed: 773501]
- Hasin D, Aharonovich E, Liu X, Mamman Z, Matseoane K, Carr And LG, Li TK. Alcohol dependence symptoms and alcohol dehydrogenase 2 polymorphism: Israeli Ashkenazis, Sephardics, and recent Russian immigrants. *Alcohol Clin Exp Res*. 2002; 26:1315–1321. [PubMed: 12351924]
- Hasin DS, Beseler CL. Dimensionality of lifetime alcohol abuse, dependence and binge drinking. *Drug Alcohol Depend*. 2009; 101:53–61. [PubMed: 19095379]
- Hasin DS, Liu X, Alderson D, Grant BF. DSM-IV alcohol dependence: a categorical or dimensional phenotype? *Psychol Med*. 2006; 36:1695–1705. [PubMed: 17038207]
- Hasin DS, Schuckit MA, Martin CS, Grant BF, Bucholz KK, Helzer JE. The validity of DSM-IV alcohol dependence: what do we know and what do we need to know? *Alcohol Clin Exp Res*. 2003; 27:244–252. [PubMed: 12605073]

- Heath AC, Whitfield JB, Madden PA, Bucholz KK, Dinwiddie SH, Slutske WS, Martin NG. Towards a molecular epidemiology of alcohol dependence: analysing the interplay of genetic and environmental risk factors. *Br J Psychiatry*. 2001; (Suppl. 40):s33–s40.
- Helzer JE, Kraemer HC, Krueger RF. The feasibility and need for dimensional psychiatric diagnoses. *Psychol Med*. 2006a; 36:1671–1680. [PubMed: 16907995]
- Helzer JE, Rose GL, Badger GJ, Searles JS, Thomas CS, Lindberg SA, Guth S. Using interactive voice response to enhance brief alcohol intervention in primary care settings. *J Stud Alcohol Drugs*. 2008; 69:251–258. [PubMed: 18299766]
- Helzer JE, van den Brink W, Guth SE. Should there be both categorical and dimensional criteria for the substance use disorders in DSM-V? *Addiction*. 2006b; 101(Suppl. 1):17–22. [PubMed: 16930157]
- Helzer J, Kraemer HC, Krueger RF, Wittchen HU, Sirovatka PJ, Regier DA. Dimensional approaches in diagnostic classification: refining the research agenda for DSM-V. *Am J Psychiatry*. 2009; 166:118–119.
- Kobak KA, Taylor LvH, Dottl SL, Greist JH, Jefferson JW, Burroughs D, Mandell M. Computerized screening for psychiatric disorders in an outpatient community mental health clinic. *Psychiatr Serv*. 1997; 48:1048–1057. [PubMed: 9255838]
- Long, JD. *Longitudinal Data Analysis for the Behavioral Sciences Using R*. SAGE Publications, Inc.; Thousand Oaks, CA: 2011.
- MacCallum RC, Zhang S, Preacher KJ, Rucker DD. On the practice of dichotomization of quantitative variables. *Psychol Methods*. 2002; 7:19–40. [PubMed: 11928888]
- Meyer RE. Finding paradigms for the future of alcoholism research: an interdisciplinary perspective. *Alcohol Clin Exp Res*. 2001; 25:1393–1406. [PubMed: 11584161]
- Moyer A, Finney JW, Swearingen CE, Vergun P. Brief interventions for alcohol problems: a meta-analytic review of controlled investigations in treatment-seeking and non-treatment-seeking populations. *Addiction*. 2002; 97:279–292. [PubMed: 11964101]
- Muthén B. Should substance use disorders be considered as categorical or dimensional? *Addiction*. 2006; 101(Suppl. 1):6–16. [PubMed: 16930156]
- National Institute of Alcohol and Alcohol Abuse. *Helping Patients With Alcohol Problems: A Clinician's Guide* (No. 05-3769). NIH; Bethesda, MD: 2005.
- Pinheiro, J.; Bates, D.; DebRoy, S.; Sarkar, D. R Development Core Team. *nlme: Linear and Nonlinear Mixed Effects Models*. Foundation for Statistical Computing; Vienna: 2012.
- R Development Core Team. *R: A Language and Environment for Statistical Computing*. Foundation for Statistical Computing; Vienna: 2012. <http://www.R-project.org/>
- Searles JS, Perrine MW, Mundt JC, Helzer JE. Self-report of drinking using touch-tone telephone: extending the limits of reliable daily contact. *J Stud Alcohol Drugs*. 1995; 56:375.
- Tarter RE, Moss HB, Arria A, Mezzich AC, Vanyukov MM. The psychiatric diagnosis of alcoholism: critique and proposed reformulation. *Alcohol Clin Exp Res*. 1992; 16:106–116. [PubMed: 1558290]

Table 1

Variables used in the analytic models.

DSM Models	Predictor variable	Outcome variable
Primary analyses with DSM-IV criteria		
A1	Categorical dependence (yes/no)	Total weekly alcoholic drinks
A2	Dimensional dependence (0–7)	Total weekly alcoholic drinks
A3	Dimensional AUD (0–11)	Total weekly alcoholic drinks
Secondary analysis with DSM-5 criteria		
B1	Dimensional AUD with the craving criterion operationalized as any non-zero craving rating (0–11)	Total weekly alcoholic drinks
B2	Dimensional AUD with the craving criterion operationalized as any craving rating of 3 or higher (0–11)	Total weekly alcoholic drinks
B3	Dimensional AUD with the craving criterion operationalized as any craving rating of 4 or higher (0–11)	Total weekly alcoholic drinks

Note. AUD, alcohol use disorder.

Table 2

Model fit based on AIC values.

Models	AIC value	Delta AIC
DSM-IV Categorical AD (A1)	7628.51	–
DSM-IV Dimensional AD (A2)	7625.09	3.42
DSM-IV Dimensional AUD (A3)	7625.09	3.42
DSM-5 Dimensional AUD with craving criterion based on rating of 1 or higher (B1)	7624.74	3.77
DSM-5 Dimensional AUD with craving criterion based on rating of 3 or higher (B2)	7623.88	4.63
DSM-5 Dimensional AUD with craving criterion based on rating of 4 or higher (B3)	7624.09	4.42

Notes. AIC, Akaike's information criterion. Lower values suggest *better* model fit; delta AIC, number of AIC points difference between the denoted dimensional model and the categorical model (A1); AD, alcohol dependence; AUD, alcohol use disorder.

Table 3

DSM-IV categorical and dimensional diagnoses predicting change in weekly alcohol consumption during the first four weeks following a brief intervention.

DV: total weekly alcoholic drinks consumed				
	<i>b</i>	SE	<i>p</i>	95% CI (low, high)
Categorical AD (A1)				
Intercept	27.06	2.38	0.01	22.38, 31.73
Diagnosis	5.91	2.95	0.05	0.12, 11.70
Week	−0.67	0.59	0.25	−1.83, 0.48
Diagnosis × week	−0.43	0.73	0.56	−1.86, 1.01
Dimensional AD (A2)				
Intercept	22.74	3.35	0.01	16.16, 29.32
Diagnosis	2.04	0.76	0.01	0.55, 3.54
Week	0.34	0.82	0.68	−1.27, 1.96
Diagnosis × week	−0.32	0.19	0.08	−0.69, 0.04
Dimensional AUD (A3)				
Intercept	22.34	3.59	0.01	15.30, 29.39
Diagnosis	1.48	0.57	0.01	0.36, 2.60
Week	0.64	0.88	0.47	−1.08, 2.36
Diagnosis × week	−0.28	0.14	0.05	−0.55, −0.01

Notes. DV, dependent variable; *b*, regression coefficient; SE, standard error; *p*, *p*-value; CI, confidence interval; AD, alcohol dependence; AUD, alcohol use disorder.

Table 4

DSM-5 dimensional alcohol use disorder (AUD) diagnosis predicting change in weekly alcohol consumption during the first four weeks following a brief intervention.

DV: total weekly alcoholic drinks consumed				
	<i>b</i>	SE	<i>p</i>	95% CI (low, high)
Dimensional AUD model B1				
Intercept	20.66	4.09	0.01	12.63, 28.69
Diagnosis	1.53	0.57	0.01	0.41, 2.66
Week	0.91	1.00	0.36	-1.04, 2.87
Diagnosis × week	-0.28	0.14	0.05	-0.55, -0.01
Dimensional AUD model B2				
Intercept	20.37	3.98	0.01	12.57, 28.18
Diagnosis	1.61	0.57	0.01	0.49, 2.72
Week	0.92	0.97	0.35	-0.99, 2.82
Diagnosis × week	-0.29	0.14	0.04	-0.56, -0.01
Dimensional AUD model B3				
Intercept	20.88	3.86	0.01	13.30, 28.46
Diagnosis	1.57	0.56	0.01	0.47, 2.67
Week	0.85	0.94	0.37	-1.00, 2.70
Diagnosis × week	-0.28	0.14	0.04	-0.55, -0.01

Notes. DV, dependent variable; *b*, regression coefficient; SE, standard error; *p*, *p*-value; CI, confidence interval; AUD, alcohol use disorder; model B1, model with craving criterion based on any craving rating of 1 or higher; model B2, model with craving criterion based on craving rating of 3 or higher; model B3, model with craving criterion based on craving rating of 4 or higher.