

Article

Craving as a DSM-5 Symptom of Alcohol Use Disorder in Non-Treatment Seekers

Emily E. Hartwell¹ and Lara A. Ray^{1,2,3,*}

¹Department of Psychology, University of California, Los Angeles, 1285 Franz Hall, Box 951563, CA 900951563, USA,

²Department of Psychiatry and Biobehavioral Sciences, University of California, 760 Westwood Plaza, Los Angeles, CA 90095, USA, and ³Brain Research Institute, University of California, 695 Charles Young Drive South, Los Angeles, CA 90095, USA

*Corresponding Author: Department of Psychology, University of California, Los Angeles, 1285 Franz Hall, Box 951563, CA 900951563, USA. Tel: +310-794-5383; Fax: +310-206-5895; E-mail: lararay@psych.ucla.edu

Received 11 May 2017; Revised 27 September 2017; Editorial Decision 16 October 2017; Accepted 25 October 2017

Abstract

Aims: DSM-5 has added craving as a new criterion and changed the diagnostic structure of alcohol use disorder (AUD). Though craving has long been a target of intervention, less is known about the impact this addition will have on prevalence and factor structure of AUD, particularly in non-treatment seeker with alcohol problems.

Methods: Non-treatment seeking individuals reporting alcohol-related problems ($N = 296$) completed a structured clinical interview and the Penn Alcohol Craving Scale (PACS). PACS scores greater than 20 were considered to meet diagnostic criteria for the alcohol craving symptom. This study examined DSM-IV to DSM-5 diagnostic conversion and conducted an exploratory factor analysis to test the factor structure of the DSM-5 symptoms, including craving.

Results: The mean PACS score was 13.1 and alcohol craving was strongly correlated with other measures of alcohol use. Using the proposed cut-off score of PACS > 20, 46 participants (16.2%) met criteria for alcohol craving. Craving loaded moderately (0.47) onto the retained DSM symptoms and produced a unidimensional factor structure. The majority of participants who met for a DSM-IV AUD also met for a DSM-5 AUD (98.8%).

Conclusions: Craving prevalence using the PACS was relatively low compared to the remaining 10 DSM-5 symptoms, possibly due to the non-treatment seeking nature of the sample. Conversion of DSM-IV to DSM-5 in this sample led to a small increase in overall AUD prevalence. Craving loaded well onto a single factor structure for AUD.

INTRODUCTION

Subjective craving for substances of abuse has become an increasingly salient point for the diagnosis and treatment of substance use disorders. In fact this salience has impacted the latest iteration of the Diagnostic and Statistical Manual (DSM-5; [American Psychiatric Association, 2013](#)). Published in its fifth iteration in 2013, the update has made two critical updates to the alcohol use disorder (AUD) and substance use disorder (SUD) section ([Hasin *et al.*, 2013](#)) since the previous edition, which was published in 1994 (DSM-IV). First, there was a diagnostic structure change that replaced the separate diagnoses of ‘dependence’ and ‘abuse’ with a unidimensional diagnostic

structure that qualifies a SUD by severity based on the number of symptoms endorsed (i.e. ‘Mild,’ ‘Moderate’ or ‘Severe’; [Ray *et al.*, 2008](#); [Hasin *et al.*, 2013](#)). Second, the legal criterion of abuse was dropped, due to infrequent endorsement and poor discriminant validity ([Agrawal *et al.*, 2011](#)), in favor of the addition of craving as a criterion ([Keyes *et al.*, 2011](#); [Hasin *et al.*, 2012](#)).

There is debate regarding how the structural and criteria updates to the DSM would impact prevalence. For example, epidemiological studies suggest the prevalence of AUD may increase under DSM-5 criteria due to the diagnostic structure change ([Mewton *et al.*, 2011](#); [Bartoli *et al.*, 2015](#)). However, prevalence is not expected to be

significantly impacted by the criteria change (Cherpitel *et al.*, 2010; Agrawal *et al.*, 2011). The stability in AUD prevalence between DSM editions has been viewed positively as a sudden increase in prevalence of AUDs due to criteria changes would be questionable (Tiffany and Wray, 2012). Alternatively, using the third wave of the National Epidemiological Survey on Alcohol and Related Conditions (NESARC) data, prevalence of lifetime DSM-5 AUD was lower than that of DSM-IV (29.1% versus 43.6%; Grant *et al.*, 2015). The elimination of diagnostic orphans (Hasin and Paykin, 1998; Agrawal *et al.*, 2011), individuals who meet for one to two symptoms of dependence, may also impact prevalence. Such individuals who do not meet for an AUD under DSM-IV criteria are likely to convert to a DSM-5 diagnosis (Mewton *et al.*, 2011).

Craving has previously been included in the International Classification of Diseases (ICD; World Health Organization, 2004) diagnostic system, which provides comparable prevalence rates of AUD to DSM-IV (Hasin *et al.*, 2006). Further supporting the inclusion of craving is that craving for alcohol has been predictive of alcohol consumption (Schneekloth *et al.*, 2012; McHugh *et al.*, 2016) and, with treatment, this predictive relationship can decrease over time (McHugh *et al.*, 2016). Craving is also associated with relapse (Schneekloth *et al.*, 2012) and thus has become a target for interventions, both psychosocial and pharmacological (Anton *et al.*, 1999; Addolorato *et al.*, 2005; Witkiewitz *et al.*, 2013).

Despite the approval of the DSM-5, criticism of the role of craving is addiction persists. For example, there is no unified theory on the development of craving (Drummond, 2001) and debate remains regarding whether the root is biological, psychobiological or psychosocial (Monti *et al.*, 2000). Another pertinent criticism is that there is no consensus regarding the best method of assessing craving and that cultural differences could make assessment difficult (Cherpitel *et al.*, 2010). Additionally, craving may represent a more severe symptom that may not be commonly endorsed, thus limiting incremental validity (Anton & Drobos, 1998). Though factor analyses have shown that craving loads strongly onto the other AUD criteria to form a unidimensional structure (Cherpitel *et al.*, 2010; Keyes *et al.*, 2011; Mewton *et al.*, 2011; Casey *et al.*, 2012), supporting the argument that craving is related to the other symptoms, questions have arisen regarding the differences between treatment seeking and non-treatment seeking populations. Non-treatment seekers are often used in clinical research to test safety and efficacy of new medications and in human laboratory studies that inform clinical trials (Enoch *et al.*, 2009). Evidence has arisen that treatment seeking status is likely impacting results of such studies (Perkins *et al.*, 2008) and that there are significant clinical differences in presentation between these two groups (Ray *et al.*, 2017; Rohn *et al.*, 2017). Thus, understanding craving as a symptom of AUD in non-treatment seekers is warranted.

In treatment-seeking heavy alcohol users, recent work by Murphy and colleagues (2014) showed that the eleven DSM-5 symptoms were a unidimensional system. The group capitalized on the Penn Alcohol Craving Scale (PACS; Flannery *et al.*, 1999), a widely used and well validated measure of tonic craving, as a stand in for the craving criterion. Participants with total scores of greater than 20 were considered to meet the craving symptom criteria, indicative of strong urges and great difficulty in resisting alcohol use. Accordingly, forty-seven percent of the sample met the symptom of craving based on the PACS cut-off score. It is not known whether these results translate to non-treatment seekers, a group frequently enrolled in clinical trials and behavioral studies of addiction.

In summary, evidence from preclinical, clinical, and laboratory studies support the importance of craving in the phenomenology of

AUD and as a treatment target. However, better understanding of the diagnostic function of craving is warranted, particularly among non-treatment seeking problem drinkers. Thus, the present study seeks to test: (a) how the addition of craving as an AUD symptom will alter AUD prevalence estimates and (b) how the new criterion will load onto the remaining criteria.

METHODS

Participants and Procedures

Non-treatment seekers problem drinkers were recruited from the greater Los Angeles area to participate in a laboratory study examining the impact of genotype on subjective effects of acute alcohol administration (Ray *et al.*, 2013b) with approval from the UCLA Institutional Review Board. When participants arrived for the screening visit, they provided written informed consent and completed a battery of self-report measures and clinician-administered interviews to determine eligibility. Inclusion criteria were (1) between ages 21 and 65; (2) report alcohol-related problems (assessed over the telephone by asking participants if they are currently experiencing alcohol-related problems); and (3) endorse drinking ≥ 48 drinks per month. Exclusion criteria were (1) seeking treatment or currently in alcohol treatment; (2) alcohol abstinence for the previous three weeks; (3) self-reported lifetime history of bipolar disorder or psychotic disorder and (4) lack of endorsement of DSM-IV AUD symptoms. Two hundred ninety-six individuals completed the initial in-person assessment; however, twelve individuals did not endorse symptoms of an AUD and were excluded from this secondary analysis.

Measures

After providing informed consent, participants completed a battery of individual difference measures, including: (1) demographics questionnaire querying age, gender, ethnicity and other variables; (2) the Alcohol Dependence Scale (ADS; Skinner and Horn, 1984) to assess severity of current alcohol use problems. ADS scores between 14 and 21 are thought to align with moderate alcohol dependence in this valid and reliable measure (Skinner and Allen, 1982); and (3) the Drinker's Inventory of Consequences (DrInC-2R; Miller *et al.*, 1995) which ascertained the severity of alcohol-related consequences. The DrInC, a psychometrically sound measure (Forcehimes *et al.*, 2007), total scores range from 0 to 135 where scores between 41 and 47 are considered to be in the moderate range of severity.

The Structured Clinical Interview for DSM-IV (SCID; First *et al.*, 1995), the Clinical Institute Withdrawal Assessment (CIWA-Ar; Sullivan *et al.*, 1989) and Timeline Follow-back (TLFB; Sobell *et al.*, 1986) assessed for current AUDs and age of onset, withdrawal symptomatology, and past 30-day alcohol consumption, respectively. SCID symptoms are rated on a scale of 1–3, where 1 is indicative that the symptom is absent, 2 is considered subthreshold and 3 indicates the symptom is present. The SCID is generally considered valid and reliable (Zanarini *et al.*, 2000). From the reliable and valid (Sobell *et al.*, 1988) TLFB, total number of drinking days and drinks per drinking day (DPDD) were calculated. CIWA-Ar scores greater than 10 are considered indicative of clinically relevant withdrawal symptoms and may require medical attention according to this valid and reliable assessment (Sullivan *et al.*, 1989).

Data were collected prior to the publication of DSM-5 and utilized the DSM-IV-based SCID. Thus, the PACS (Flannery *et al.*, 1999) was used to formulate the craving symptom. This psychometrically reliable and valid measure is composed of five items that capture craving over the previous week. The PACS has high construct validity with other measures of alcohol craving and high reliability

(Cronback α of 0.92; Flannery *et al.*, 1999). Participants rate each item on a scale of 0–6 for which the sum of the scores are indicative of severity of craving. Using the approach utilized by Murphy *et al.* (2014), total score greater than 20 was categorized as meeting for the craving symptom. This total score indicates that the average score on each item is at least a '4,' indicating that the individual is experiencing a 'strong urge' and that it is 'very difficult' to resist craving. Scores between 15 and 20 were considered subthreshold (i.e. 'moderate' urges and 'sometimes' thinking about drinking) and scores less than 15 were considered the symptom absent.

Data Analysis Plan

Analyses were conducted in SAS 9.3 (Cary, NC, USA). First, demographic and substance use variables were calculated. In order to meet the first study aim, participants were placed into the correct diagnostic categories: abuse (without dependence), dependence, any DSM-IV diagnosis (abuse and/or dependence), diagnostic orphans (i.e. participants who met 1–2 dependence criteria and no symptoms of abuse) using the DSM-IV SCID data. Next, the total number of SCID symptoms, with the subtraction of the legal question and the addition of craving, was calculated. Participants were then placed into the appropriate DSM-5 categories (i.e. no, mild, moderate, or severe AUD) based on the number of symptoms reported. Cross-tabulations were used to compare diagnostic conversion. Correlations between all possible diagnostic symptoms and indicators of alcohol use, namely DrINC, ADS and alcohol use in the past month as calculated from the TLFB, were computed.

To meet the second study aim, exploratory factor analysis (EFA) was conducted. First, the ten retained symptoms from the DSM-IV were examined and, secondly, craving will be added in order to resemble the DSM-5 structure. The EFA approach utilized principle axis factoring (PAF). PAF alters the correlation matrix to represent communalities between each set of variables. This method additionally allows each variable to be influenced by unique error. Eigenvalues and Scree plots were examined to determine the number of optimal number of factors to retain. Items loadings of 0.30 or greater were considered significant.

RESULTS

Demographics

Participants were predominantly young, male and Caucasian (Table 1). Participants endorsed drinking for a mean of 18.3 days in the previous month and reported 7.2 drinks per drinking day (DPDD). Withdrawal was minimal (CIWA mean = 5.7), whereas indicators of alcohol use severity were elevated (ADS mean = 15.8, DRINC = 44.7). Of the eleven total possible AUD symptoms, participants met for an average of 5.5 symptoms.

Craving Endorsement

Craving, as determined by the PACS cut-off score, was met by 16.2% of the sample ($n = 46$), and 21.8% were considered subthreshold (Table 1). Craving was significantly correlated with other measures of alcohol use, specifically the DRINC, ADS, number of drinking days and DPDD (Table 2); further, craving had the strongest correlation with the first three of these measures as compared to the other AUD symptoms. However, like the legal criterion, craving was the least frequently endorsed symptom compared to the other 10 retained symptoms.

Table 1. Demographic and substance use variables

	Mean (SD) or % (N)
Demographics	
Age	30.9 (10.4)
Male	73.1 (204)
Ethnicity	
Caucasian	55.0 (153)
African American	24.5 (68)
Native	6.5 (18)
Latino	22.7 (63)
Asian	9.4 (26)
Substance use variables	
PACS	13.1 (6.5)
DPDD	7.2 (4.7)
Drinking days	18.3 (7.2)
Total number DSM-IV AUD symptoms	5.5 (2.7)
Age of AUD onset	24.1 (8.7)
CIWA	5.7 (7.0)
DRINC	44.7 (22.7)
ADS	15.8 (7.4)
Endorsed daily nicotine use	24.1 (71)
Alcohol craving	
PACS > 20	16.2 (46)
PACS 15–20	21.8 (62)
PACS < 15	62.0 (176)

Drinks per drinking day (DPDD), Clinical Institute Withdrawal Assessment (CIWA), Drinkers Inventory of Consequences (DRINC), Alcohol Dependence Scale (ADS).

DSM-IV versus DSM-5 AUD Prevalence

Per DSM-IV criteria, the 75.3% of the sample would have met for dependence, 12.3% met for abuse without dependence and 12.3% were diagnostic orphans. According to DSM-5 criteria, 5.6% of the sample would not meet for an AUD, 21.1% would meet for mild, 24.7% moderate and 48.6% severe. Table 3 shows the conversion of participants from DSM-IV to DSM-5 diagnostic structure. Of those meeting for DSM-IV abuse without dependence, the majority went on to meet for mild or moderate AUD (91.4%). All subjects who met for DSM-IV dependence also met for an AUD in DSM-5. Of the 249 participants who met for either abuse or dependence, only 3 did not convert to a DSM-5 diagnosis meaning 98.8% continue to meet for a diagnosis. Further, the majority of those meeting for any DSM-IV diagnosis were moderate (28.1%) or severe (55.4%) when converted to DSM-5 structure. Of the 35 diagnostic orphans in the sample, only 37.1% of participants remained undiagnosed whereas the rest converted to a mild AUD in DSM-5.

Factor Analysis of Retained DSM-IV Criteria and Craving

Table 4 shows the results of the EFA for the ten retained DSM-IV symptoms and with the inclusion of the PACS craving symptom. Both models had a Kaiser's measure of sampling adequacy above 0.80, indicating sufficient correlation matrices. Eigenvalues and scree plots indicated a unidimensional factor structure. For the model of retained DSM-IV symptoms, the eigenvalue of the single extracted factor was 2.32, accounting for 73% of the variance. Including craving did not significantly alter factor structure and results showed that it loads moderately well (0.47) onto existing symptoms. The eigenvalue of the eleven DSM-5 symptoms was 2.53 and accounted for 72% of the variance. For both models, loadings

Table 2. Percentage of endorsement and frequency for each symptom of AUD. Correlations of all symptoms with other indices of alcohol use

		% Endorsement (Frequency)	Correlations			
			DRINC	ADS	Drinking days	DPDD
Abuse	Inability to fulfill major roles	44.4 (126)	0.36***	0.31***	0.12	0.04
	Hazardous use	44.7 (127)	0.17**	0.11 [†]	0.14*	0.003
	Legal issues	18.0 (51)	0.28***	0.2***	0.15*	0.22***
	Social & interpersonal problems	46.8 (133)	0.37***	0.31***	0.12*	0.21***
Dependence	Drinking more than intended	80.3 (228)	0.07	0.14*	−0.02	0.003
	Inability/persistent desire to cut down	50.0 (141)	0.29***	0.22***	0.12*	0.17**
	Time spent obtaining/ recovering	51.8 (147)	0.35***	0.36***	0.22***	0.27***
	Activities reduced	37.7 (107)	0.46***	0.32***	0.24***	0.19**
	Psychological/physical problems	63.4 (180)	0.28***	0.35***	0.07	0.10 [†]
	Tolerance	81.0 (230)	0.19**	0.39***	0.27***	0.12*
	Withdrawal	32.8 (93)	0.44***	0.39***	0.27***	0.12*
	Craving	16.2 (46)	0.49***	0.46***	0.32***	0.20***

Significance indicated: *** $P < 0.001$, ** $P < 0.01$, * $P < 0.05$, [†] $P < 0.10$.

Note: DRINC is the Drinker's Inventory of Consequence, ADS is the Alcohol Dependence Scale, DPDD is drinks per drinking day.

Table 3. Transition from DSM-IV to DSM-5 AUD diagnoses (%) for the full sample ($n = 284$)

	DSM-5			
	No AUD ($n = 16$)	Mild AUD (2–3 symptoms) ($n = 60$)	Moderate AUD (4–5 symptoms) ($n = 70$)	Severe AUD (6+ symptoms) ($n = 138$)
DSM-IV abuse (without dep) ($n = 35$)	8.6	71.4	20.0	0
DSM-IV dependence ($n = 214$)	0	6.1	29.4	64.5
DSM-IV abuse/dependence ($n = 249$)	1.2	15.3	28.1	55.4
DSM-IV diagnostic orphans ($n = 35$)	37.1	62.9	0	0

Table 4. EFA of AUD symptoms in retained Diagnostic and Statistical Manual-IV (DSM-IV) symptoms and DSM-5

	Retained DSM-IV	DSM-5
Activities reduced	0.62	0.64
Social and interpersonal problems	0.58	0.58
Withdrawal	0.55	0.57
Psychological/physical problems	0.55	0.54
Time spent obtaining/recovering	0.53	0.53
Inability to fulfill major roles	0.53	0.52
Craving	—	0.47
Inability/persistent desire to cut down	0.45	0.44
Hazardous use	0.30	0.30
Tolerance	0.27	0.26
Drinking more than intended	0.25	0.25

were similar and all positively loaded onto the single factor; however, two symptoms fell below the predetermined significance level: tolerance and drinking more than intended.

DISCUSSION

The current study sought to examine the impact of the addition of craving on prevalence and the factor structure of DSM-5 AUD diagnosis in a community sample of non-treatment seeking heavy alcohol users. Converting DSM-IV diagnostic status to DSM-5 showed an increase in overall prevalence of AUD from 87.7 to 94.3%. This

increase was primarily due to the conversion of diagnostic orphans to a DSM-5 diagnosis, at a rate considerable higher than what [Mewton *et al.* \(2011\)](#) observed. Similar to [Mewton *et al.* \(2011\)](#), all individuals who endorsed DSM-IV dependence converted to a DSM-5 AUD diagnosis, predominantly moderate or severe.

[Bartoli *et al.* \(2015\)](#) concluded that DSM-5 would likely increase prevalence of AUD based off their review of twelve epidemiological studies. Moreover, they posited this increase is primarily due to non-clinical populations and the conversion of diagnostic orphans to diagnosis. This aligns with findings presented herein where a non-clinical sample demonstrated increased prevalence of AUD with DSM-5 structure given the high rate of orphan conversion. Due to this increased rate of diagnosis, the threshold of two symptoms to meet for an AUD may be too low, potentially leading to over pathologizing of alcohol use problems as the prevalence rate of AUD will be artificially inflated.

Craving, here assessed via the PACS, was significantly correlated with all measures of alcohol use (i.e. DrINC, ADS and TLFB indications). The craving correlations were stronger than those of the legal symptom correlations. When examining factor structure of the retained DSM-IV symptoms, and subsequently with the added symptom of craving, the unidimensional factor structure was demonstrated in both models with a single factor accounting for a majority of the variance. Akin to [Casey *et al.* \(2012\)](#), who utilized NESARC data, factor analysis showed that craving fit in well to the unidimensional structure proposed by DSM-5. These findings are also consistent with [Murphy *et al.* \(2014\)](#) who also found a similar unidimensional structure in a treatment seeking sample by utilizing

the PACS and, furthermore, extends results to a non-treatment seeking population. Though this utilization of the PACS in this manner is an atypical approach, this measure is widely used and a psychometrically sound assessment of tonic craving. As noted by Murphy *et al.*, the DSM is categorical in nature and a certain threshold of severity must be met for a symptom to become clinically relevant and considered impairing. Though the study should be interpreted with the caveat of this unusual approach to craving diagnosis, the PACS cut-off did correlate strongly with other measures of alcohol consumption and problematic use lending support to the validity of this approach. Two symptoms, tolerance and drinking more than intended, did not load strongly onto the single factor structure perhaps due to the high endorsement of these symptoms, a pattern similar to that observed by Mewton *et al.* (2011).

Despite these findings, the low endorsement of craving must be noted; 46 participants (16.2%) met for craving using the cut-off score. This level of endorsement is in contrast to Murphy *et al.* (2014) where nearly half of the sample endorsed clinically significant craving using the PACS. As earlier noted, craving is thought to be a more severe symptom of AUD. For example, in nationally representative samples, craving has been demonstrated to be a moderate to severe symptom as compared to the other 10 symptoms of AUD (Keyes *et al.*, 2011; Casey *et al.*, 2012), thus corroborating the relatively low endorsement in this sample. This discrepancy may relate to the difference in treatment status between the samples (Anton and Drobos, 1998). Recent research has also suggested that treatment seekers likely represent a more severe group of alcohol users who have been shown to endorse a greater number of AUD symptoms and higher craving scores (Ray *et al.*, 2017; Rohn *et al.*, 2017). Alternatively, craving is also a heterogeneous experience both within and between alcohol using individuals. The PACS administered in this study assessed past week craving, which may not have fully captured individual's experience or the predetermined cut-off may be too high for this non-treatment seeking sample.

Strengths of the study include the large, diverse sample of community alcohol users who are reflective of the individuals typically recruited for clinical laboratory research. This study also utilized the PACS to assess craving, a widely used, reliable, and well validated assessment. The multi-question structure yields a composite score of craving that may be advantageous over single-item assessment (Ray *et al.*, 2013a). Limitations of the study include the modest sample size for factor analysis and use of the PACS to replace a criterion typically assessed via structured interview. Future studies should consider the relationship between self-report and interview assessment of craving and the role treatment status plays in this relationship.

In conclusion, this study in non-treatment seeking individuals found support of the structural change to collapse the DSM-IV AUD categories of abuse and dependence into the single unidimensional syndrome. Craving loaded well onto existing symptoms, despite being a less frequently endorsed symptom. Although prevalence did increase in this sample, this was primarily due to the diagnostic switching of diagnostic orphans who came to meet criteria for a mild AUD. Further exploration of the assessment and development of craving as individuals progress in AUD severity is warranted.

FUNDING

This study was supported by grants from ABMRF, the Foundation for Alcohol Research, and the UCLA Clinical and Translational Science Institute.

CONFLICT OF INTEREST STATEMENT

None declared.

REFERENCES

- Addolorato G, Abenavoli L, Leggio L, *et al.* (2005) How many cravings? pharmacological aspects of craving treatment in alcohol addiction: a review. *Neuropsychobiology* 51:59–66.
- Agrawal A, Heath AC, Lynskey MT. (2011) DSM-IV to DSM-5: the impact of proposed revisions on diagnosis of alcohol use disorders. *Addiction* 106:1935–43.
- American Psychiatric Association. (2013) *Diagnostic and Statistical Manual of Mental Disorders*, 5th edn. Arlington, VA: American Psychiatric Association.
- Anton RF, Drobos DJ. (1998) Clinical measurement of craving in addiction. *Psychiatry Ann* 28:553–60.
- Anton RF, Moak DH, Waid LR, *et al.* (1999) Naltrexone and cognitive behavioral therapy for the treatment of outpatient alcoholics: results of a placebo-controlled trial. *Am J Psychiatry* 156:1758–64.
- Bartoli F, Carrà G, Crocamo C, *et al.* (2015) From DSM-IV to DSM-5 alcohol use disorder: an overview of epidemiological data. *Addict Behav* 41:46–50.
- Casey M, Adamson G, Shevlin M, *et al.* (2012) The role of craving in AUDs: dimensionality and Differential Functioning in the DSM-5. *Drug Alcohol Depend* 125:75–80.
- Cherpitel CJ, Borges G, Ye Y, *et al.* (2010) Performance of a Craving Criterion in DSM Alcohol Use Disorders. *J Stud Alcohol Drugs* 71:674–84.
- Drummond DC. (2001) Theories of drug craving, ancient and modern. *Addiction* 96:33–46.
- Enoch MA, Johnson K, George DT, *et al.* (2009) Ethical considerations for administering alcohol or alcohol cues to treatment-seeking alcoholics in a research setting: Can the Benefits to Society Outweigh the Risks to the Individual? *Alcohol Clin Exp Res* 33:1508–12.
- First MB, Spitzer RL, Gibbon M, *et al.* (1995) *Structured Clinical Interview for DSM-IV Axis I Disorders, Patient Edition*. New York: New York State Psychiatric Institute.
- Flannery BA, Volpicelli JR, Pettinati H. (1999) Psychometric properties of the Penn Alcohol Craving Scale. *Alcohol Clin Exp Res* 23:1289–95.
- Forcehimes AA, Tonigan JS, Miller WR, *et al.* (2007) Psychometrics of the drinker inventory of consequences (DrInC). *Addict Behav* 32:1699–1704.
- Grant BF, Goldstein RB, Saha TD, *et al.* (2015) Epidemiology of DSM-5 alcohol use disorder: results from the national epidemiologic survey on alcohol and related conditions III. *JAMA Psychiatry* 72:757–66.
- Hasin DS, Fenton MC, Beseler C, *et al.* (2012) Analyses related to the development of DSM-5 criteria for substance use related disorders: 2. Proposed DSM-5 criteria for alcohol, cannabis, cocaine and heroin disorders in 663 substance abuse patients. *Drug Alcohol Depend* 122:28–37.
- Hasin DS, Hatzenbuehler ML, Keyes K, *et al.* (2006) Substance use disorders: diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV) and International Classification of Diseases, tenth edition (ICD-10). *Addiction* 101:59–75.
- Hasin DS, O'Brien C, Auriacombe M, *et al.* (2013) DSM-5 criteria for substance use disorders: recommendations and rationale. *Am J Psychiatry* 170:834–51.
- Hasin DS, Paykin A. (1998) Dependence symptoms but no diagnosis: diagnostic 'orphans' in a community sample. *Drug Alcohol Depend* 50:19–26.
- Keyes K, Krueger R, Grant B, *et al.* (2011) Alcohol craving and the dimensionality of alcohol disorders. *Psychol Med* 41:629–40.
- McHugh RK, Fitzmaurice GM, Griffin ML, *et al.* (2016) Association between a brief alcohol craving measure and drinking in the following week. *Addiction* 111:1004–10.
- Mewton L, Slade T, McBride O, *et al.* (2011) An evaluation of the proposed DSM-5 alcohol use disorder criteria using Australian national data. *Addiction* 106:941–50.
- Miller WR, Tonigan JS, Longabaugh R. (1995) *The Drinker Inventory of Consequences (DrInC): An Instrument for Assessing Adverse Consequences of Alcohol Abuse: Test Manual*. Rockville, Maryland: US Department of Health and Human Services, Public Health Service, National Institutes of Health, National Institute on Alcohol Abuse and Alcoholism.

- Monti PM, Rohsenow DJ, Hutchison KE. (2000) Toward bridging the gap between biological, psychobiological and psychosocial models of alcohol craving. *Addiction* 95:229–36.
- Murphy CM, Stojek MK, Few LR, *et al.* (2014) Craving as an alcohol use disorder symptom in DSM-5: an empirical examination in a treatment-seeking sample. *Exp Clin Psychopharmacol* 22:43–9.
- Perkins K, Lerman C, Stitzer M, *et al.* (2008) Development of procedures for early screening of smoking cessation medications in humans. *Clin Pharmacol Ther* 84:216–21.
- Ray LA, Bujarski S, MacKillop J, *et al.* (2013b) Subjective response to alcohol among alcohol-dependent individuals: effects of the Mu Opioid Receptor (OPRM1) Gene and Alcoholism Severity. *Alcohol Clin Exp Res* 37: E116–24.
- Ray LA, Bujarski S, Yardley MM, *et al.* (2017) Differences between treatment-seeking and non-treatment-seeking participants in medication studies for alcoholism: do they matter? *Am J Drug Alcohol Abuse* 1–8.
- Ray L, Courtney K, Bacio G, *et al.* (2013a) The assessment of craving in addiction research. In Mackillop J, DeWit H (eds). *Addiction Psychopharmacology*. Malden, MA: Wiley-Blackwell, 345–80.
- Ray LA, Kahler CW, Young D, *et al.* (2008) The factor structure and severity of DSM-IV alcohol abuse and dependence symptoms in psychiatric outpatients. *J Stud Alcohol Drugs* 69:496–9.
- Rohn MC, Lee MR, Kleuter SB, *et al.* (2017) Differences Between Treatment-Seeking and Nontreatment-Seeking Alcohol-Dependent Research Participants: An Exploratory Analysis. *Alcohol Clin Exp Res* 41:414–20.
- Schneekloth TD, Biernacka JM, Hall-Flavin DK, *et al.* (2012) Alcohol craving as a predictor of relapse. *Am J Addict* 21:S20–6.
- Skinner HA, Allen BA. (1982) Alcohol dependence syndrome: measurement and validation. *J Abnorm Psychol* 91:199–209.
- Skinner HA, Horn JL. (1984) *Alcohol Dependence Scale (ADS) user's guide*, Addiction Research Foundation Toronto.
- Sobell MB, Sobell LC, Klajner F, *et al.* (1986) The reliability of a timeline method for assessing normal drinker college students' recent drinking history: utility for alcohol research. *Addict Behav* 11:149–61.
- Sobell LC, Sobell MB, Leo GI, *et al.* (1988) Reliability of a timeline method: Assessing normal drinkers' reports of recent drinking and a comparative evaluation across several populations. *Br J Addict* 83:393–402.
- Sullivan JT, Sykora K, Schneiderman J, *et al.* (1989) Assessment of alcohol withdrawal: the revised clinical institute withdrawal assessment for alcohol scale (CIWA-Ar). *Br J Addict* 84:1353–7.
- Tiffany ST, Wray J. (2012) The clinical significance of drug craving. *Ann NY Acad Sci* 1248:1–17.
- Witkiewitz K, Bowen S, Douglas H, *et al.* (2013) Mindfulness-based relapse prevention for substance craving. *Addict Behav* 38:1563–71.
- World Health Organization. (2004) *International Statistical Classification of Diseases and Related Health Problems*. Geneva, Switzerland: World Health Organization.
- Zanarini MC, Skodol AE, Bender D, *et al.* (2000) The collaborative longitudinal personality disorders study: Reliability of axis I and II diagnoses. *J Pers Disord* 14:291–9.