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Kavanagh, D.J., Statham, D.J., Feeney, G.F.X., Young, R. McD., May, J., Andrade, J. & Connor, J. (2013) Measurement of alcohol craving. *Addictive Behaviors*, 38, 1572-1584 . Doi: 10.1016/j.addbeh.2012.08.004

Measurement of Alcohol Craving

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Length: 7903 words + abstract, highlights, tables and references

Abstract

Despite considerable research activity and application in treatment, the construct of craving remains poorly understood. We propose that cravings and urges are cognitive-emotional events in time, characterised by frequency, duration, intensity and salience. Commonly used measures of alcohol craving are reviewed, and their strengths and weaknesses identified. Most measures confound craving with behaviors, or with separable cognitive phenomena such as expectancies, intentions, or perceived behavioral control. These confounds have limited our advances in understanding the determinants and consequences of craving. Based on the criteria applied in this review, among the better performing multi-item measures are the Penn Alcohol Craving Scale and Obsessive subscale of the Obsessive-Compulsive Drinking Scale. Optimal assessment strategies are likely to involve daily assessments of peak intensity of cravings, desires or urges and of the frequency and duration of craving episodes. Of particular interest are measures of intensity at times when individuals are at risk of drinking or of other functional impacts from craving.

158 words

Highlights

- Distinction of craving from associated but separable phenomena such as intentions, plans, self-efficacy and perceived control.
- A focus on desires and urges for alcohol as cognitive-emotional events, characterised by frequency, duration and intensity.
- A critical review of theoretical and psychometric characteristics of existing measures of alcohol craving.
- A recommended focus on peak cravings, desires or urges, and on their frequency and duration, using daily measures or assessments in high-risk situations.

Keywords: alcohol, craving, measurement; assessment, psychometric

1. Introduction

Over the last 20 years, craving has received significant attention as a key feature of addictive disorders (Leggio, 2009). The introduction of pharmacotherapies thought to target craving (Garbutt, 2010; Rosner et al., 2010) and advances in our understanding of its neural substrate (Heinz, Beck, Grusser, Grace, & Wrase, 2009; Sinha & Li, 2007) have increased attention in this area. While craving has been a feature of ICD-10 alcohol dependence for some time, likely inclusion as a criterion for Alcohol Use Disorder in DSM-5 should stimulate renewed interest in the importance of robust craving measurement.

When Sayette et al. (2000) reviewed the psychometric requirements of craving measures, they concluded that research in measurement selection needed to be driven by a clear theoretical framework, to help determine whether a measure is able to discriminate between craving, its causes and consequences. We argue that this remains true today. Given recent advances in our understanding of both the psychology and neurobiology of desires and urges, it is timely to reconsider the assessment of craving in relation to these empirical and theoretical advances. Pavlick, Hoffman & Rosenberg (2009) surveyed US substance abuse treatment agencies and found that while almost half made craving a target of treatment, only 5% used published self-report measures, with 86% asking open-ended questions and 57% using a single numbered rating scale. Such idiosyncratic and inconsistent approaches to the measurement of craving significantly limit scientific investigation of the phenomenon and its treatment.

Craving can cause distress and discomfort, particularly during abstinence attempts. It appears to be associated with alcohol consumption and relapse. However, other factors are also known to be important, including environment, expectancies, mood, self-efficacy, and

intentions. As this review will show, many measures of craving confound these factors with craving itself, and also include measures of drinking. To test the role of craving in drinking behavior, and to test the locus of action of potential interventions, it is essential to use a measure of craving that is uncontaminated by other potential determinants or consequences.

1.1. Definitional and conceptual issues: implications for measurement

1.1.1 What craving is:

ICD-10 describes craving as “a strong desire or sense of compulsion to take the substance” (WHO, 1993, p. 70). However, it is important to note that the ICD-10 does not restrict craving to intense episodes only (Sitharthan, McGrath, Sitharthan & Saunders, 1992). While intense desires and seemingly irresistible urges are of special interest to both prediction and diagnosis, they constitute only the most extreme segments of desire and urge continua. Desires of moderate and even mild intensities may also be important to assess—both as targets for intervention and as indicators of change. Drinking can occur at mild intensities of desires or urges if countervailing motivations are not strong or salient (Tiffany & Conklin, 1990). Consequently, detection of treatment effects requires measurement precision across the full severity continuum. We therefore include both measures of strong desires or urges, and ones that extend more broadly across the range of intensities.

To this end, we adopt the description of human desire as “an affectively charged cognitive event in which an object or activity that is associated with pleasure or relief of discomfort is in focal attention”, following Kavanagh, Andrade & May (2005, p. 447). While desire’s precursors and consequences may often be outside conscious awareness, the desire itself is, by definition, conscious. Consistent with usage in both ICD and DSM descriptions,

this definition captures both wishes and urges, despite the fact that they have subtly different experiential characteristics (awareness of the attractiveness of alcohol or its anticipated effects, or of the strength of response preferences to acquire or drink alcohol) and may potentially have distinguishable neural activation. In practice, ratings of craving and urges are closely associated (Rosenberg & Mazzola, 2007), and the same episode is likely to involve consideration of both the desired target and activity. In principle, capturing both concepts may offer a better chance of describing these tightly interlinked phenomena than attempting to force respondents to distinguish them.

The above definition has several important implications for assessment. Even if the person misattributes the cause of their internal state (e.g. that cocaine craving increases after exposure to erotic cues, Bauer & Kranzler, 1994), they are aware of the object of their subjective desire. This awareness allows desire to be amenable to contemporaneous self-report. Furthermore, it means that a self-report of alcohol cravings or urges may provide a better representation of the desire than a physiological measure. First, the person may not be aware of their response (e.g. conditioned salivation in response to alcohol cues, Monti et al., 1993). Second, physiological measures (e.g. heart rate, EEG) are also triggered by extraneous factors (e.g. increased physiological arousal when exposed to alcohol cues may be due to anxiety about losing control of drinking). As a result, poor correspondence with physiological measures (e.g. Maude-Griffin & Tiffany, 1996) does not imply that a self-report is invalid.

While a conscious experience allows contemporaneous self-report, consciousness does not guarantee accuracy. In common with other subjective experiences such as pain or affective states, no absolute scale of desires or urges can be derived, so the meaning of specific ratings may vary across individuals or over time. Furthermore, if a report is made

retrospectively, it relies on the extent the experience was attended to and encoded, and whether the person can later retrieve that information. Episodes of intense or prolonged craving are likely to be salient, but it is less clear that specific instances of mild or transient desires or urges will be accurately recalled, although further data on this issue are needed. Summary estimates of usual or average levels are particularly prone to error, since people are poor at averaging variable phenomena, and these reports are highly subject to availability biases (Nisbett & Ross, 1980). Prediction from reports of typical or usual craving can only be relied on if they have little variability (i.e. if craving operates more like a trait than a state). However, we know from ecological momentary assessments that levels can change markedly over time (Oslin et al., 2009). In the presence of such variation, frequency estimates or recall of intense episodes may be the best that can be done retrospectively.

Measures that focus only on current desires or urges also have limitations. The rating process draws attention to the desire, and may trigger associated thoughts, further elaboration or attempts at cognitive control. In addition, reliance on a single snapshot in time places heavy reliance on the representativeness of that moment. For example, a momentary craving assessment during a clinical session may have little relevance to craving at home, 6 months later. However, momentary assessment within a specific high-risk situation can be predictive of later drinking under some circumstances. While cross-situational consistencies in human behavior are limited, people often behave similarly in equivalent contexts (Mischel, 1968). Higley and colleagues (2011) were able to predict drinking at 10 weeks from a single administration of a visual analogue craving scale that was administered after a stress induction task. A plausible explanation for the result is that the prediction was enabled by a similar elicitation of craving by stressful situations that subsequently occurred in the natural environment. Such examples are expected to be the

exception rather than the rule: The intensity of craving is expected to have its primary impact on decisions to drink at the time of the craving episode. Cross-sectional ratings are expected to be more predictive of drinking over short intervals than after extended delays, unless craving and other contextual factors in the two situations closely correspond.

Since desires are events in time (Kavanagh et al., 2005), they are characterised by *frequency* and *duration*. The involvement of affect implies dimensions of *intensity*, and the involvement of attention implies a dimension of *salience*, which may be associated with affective intensity, but may also be driven by aspects of the environment, concurrent activities, and characteristics of relevant cues. Further articulation of the affective response could also include its *valence* (whether positive or aversive), and whether positive aspects involve *relief* (e.g. ameliorating withdrawal symptoms) or *pleasure* (e.g. euphoria). Across each of these aspects, desires can be described in terms of their *trajectory* over time. Finally, mention of the object (the alcoholic drink) or activity (i.e. drinking) and of the pleasure or relief implies cognitive *content* (i.e. the nature of the focal sensory experiences and thoughts).

These characteristics may not equally contribute to prediction. For example, Shiffman et al. (1997) found that intensity of craving for cigarettes upon waking predicted lapses to smoking that day (after controlling for baseline intensity and nicotine dependence), whereas frequency or duration of temptations on the previous day were not predictive. It is less clear which characteristics of alcohol craving may best predict subsequent drinking.

1.1.2 What craving is not:

If we are to more clearly understand causal pathways that underpin craving and give it predictive power, we argue that a high standard of conceptual rigour in its measurement is required—one that is sensitive to potential disjunctions between craving and phenomena that may occur around the same time.

Cravings or urges must clearly be distinguished from the latency, frequency or amount of alcohol consumed. While such proxy indicators are sometimes used in animal research (since self-report is impossible), craving and consumption of course are different phenomena. Nor are cravings intentions or plans to drink which, like drinking itself, can occur when craving is low.

More subtly, while strong desires or urges pose challenges for control, craving is not a lack of self-efficacy or perceived loss of control. Self-efficacy judgments reflect whether someone believes they can mobilise coping strategies to address current situational challenges (Bandura, 1986). Confidence in alcohol control can be undermined by factors that have nothing to do with craving (e.g. perceived difficulty in withstanding social pressure to drink). Conversely, a person may be confident they can control drinking even when craving is high (e.g. by engaging in incompatible activities or seeking help). As a result, craving or urge intensity typically is only moderately associated with self-efficacy (Gwaltney, Shiffman & Sayette, 2005).

When drinkers are craving alcohol, they focus on perceptions of their current needs, and of the reward or relief they may experience if they have a drink. These anticipated benefits are fed by memories of pleasurable past experiences, and by beliefs about alcohol's effects (Kavanagh et al., 2005). However, whether alcohol was pleasurable or is thought to have positive effects does not constitute craving: It is only when these thoughts have current relevance that they become part of the craving episode. Expectancy measures and

questions about past experiences are not assessments of craving measures, but reports of current, affectively charged preoccupations with alcohol effects are.

These considerations rule out some potential measures from the current review. For example, the Alcohol Craving Scale Based on 3 Factors (ACS-3F; Jimenez, Grana, Montes, & Rubio, 2009) has items giving retrospective reports of perceived effects of alcohol (“Drinking made things seem perfect”), reasons for drinking (“I drank to have fun”) and loss of control (e.g. “I found it difficult to go even one day without a drink”). None of these constitute craving under the present definition.

We also exclude the Temptation and Restraint Inventory (TRI; Collins & Lapp, 1992) from detailed review. Closest to our definition were a subset of items in the Cognitive Control of Drinking Scale. Exploratory and confirmatory factor analyses on these items derived 2 factors: Cognitive Preoccupation and Concern about Drinking. Only Cognitive Preoccupation corresponded to our current definition of craving: these items focused on intrusive thoughts and their ability to capture attention (inability to stop thinking about drinking, distract oneself, thoughts intruding into daily activities). Responses were on a scale from lack of preoccupation (1) to a high degree (9). However, in a factor analysis of the whole TRI, the CCDS Cognitive Preoccupation factor loaded with items on “Govern” (difficulty controlling drinking) and “Emotion” (likelihood of drinking or need when anxious, lonely or nervous), to form the TRI factor of Cognitive and Emotional Preoccupation (CEP). The former did not specify that the difficulty related to craving, and only one item in the latter subscale involved craving (“Do you ever feel so nervous that you really need a drink”). The other factor, Cognitive and Behavioral Control (CBC), comprised attempts to control drinking and concern about drinking, which also fall outside our definition of craving. These higher order TRI factors were later confirmed in a clinical sample (Connor et al., 2004).

Unfortunately, subsequent research has typically used the confounded factor of CEP (e.g. Jones, Cole, Goudie, & Field, 2012), rather than focusing more precisely on craving. As a result, the TRI has only peripheral relevance to the present paper.

1.2. General principles of measurement

Analysis of a measure's internal structure offers a sophisticated understanding of its constituents, and provides the basis for further tests of construct validity. Since craving is better characterised as a state than a trait (Oslin, Cary, Slaymaker, Collieran & Blow, 2009; Shiffman et al., 1997), test-retest reliability is less relevant, although some stability may be seen when craving is averaged over time or is virtually extinguished (Bohn, Krahn & Staehler, 1995). The construct validity of a measure can be assessed by showing that it correlates with other relevant measures, and that it does not correlate with measures that it should be unrelated to. It should also be able to discriminate between groups that vary in diagnosis or degree of consumption or dependence.

We contend that the ultimate tests of the practical utility of a craving measure are its predictive validity and its sensitivity to change. A key indicator is its ability to contribute uniquely to the prediction of subsequent drinking—specifically, whether it predicts drinking after control for previous consumption. Its impact on productivity and other functional indices also is important, and in fact, may sometimes be even more critical to the patient than their risk of consumption (Connor, Saunders & Feeney, 2006). If a measure is to provide a useful indicator of true changes in alcohol craving, it must also be sensitive to manipulations that are known to affect craving (e.g. rising during cue exposure and alcohol withdrawal, falling with habituation to alcohol cues or after extended abstinence).

In evaluating the predictive utility of an alcohol measure, it is important to recognise that alcohol craving is unlikely to be the only determinant of later drinking (Rohsenow &

Monti, 1999). Firstly, it may not be the only desire in operation. When a person is attempting to abstain or moderate drinking, cravings typically occur in a context of opposing motivations to maintain control. The decision situation may then involve significant ambivalence or alternations of these motivational factors. Measurement of this ambivalence may be important to the prediction of behavior (for example, see the Approach and Avoidance of Alcohol Questionnaire; McEvoy, Stritzke, French, Lang, & Ketterman, 2004). In the absence of a desire not to drink, there is no reason to resist an urge to drink, and drinking may occur at low levels of desire, constraining the ability of desire intensity to predict drinking. However, desires to control drinking should be distinguished from desires or urges to drink, which form the focus of this paper.

Furthermore, drinking has multiple determinants, including the availability and cost of alcohol, modelling, social and other incentives, coping skills and habitual or overlearned responses, which all constrain predictions of drinking from craving and other cognitive phenomena. In the absence of strong incentives to constrain drinking, it should be unsurprising that it may occur at low levels of craving. Unless we are on a diet, we rarely wait until we are ravenous to obtain food. Consistent with these considerations, De Wit (2000) summarised several small laboratory studies using a single-item VAS rating of desire for alcohol, and reported that while desire was increased by priming doses of alcohol and reduced by inhibitory doses of naltrexone, actual choice of alcohol or monetary rewards were inconsistent and reflected other factors, such as self-control and concern over negative expectancies. Optimal prediction of drinking would need to incorporate its multiple determinants, which include, but are not restricted to, craving.

2. Application of these considerations to measures of alcohol craving

In the remainder of this paper, we apply these principles to selected measures of craving. Table 1 displays the aspects of craving that a measure appears to test, and whether it also includes extraneous constructs, while Table 2 summarises data on the measures' reliability and validity. The review was informed by searches in Medline, Web of Science and PsycArticles, for papers published between 1990 and June 2012 whose titles met the three criteria that they contain words matching the search terms (1) alcohol* or drinking; (2) crav*, desire*, urge* or obsess*; and (3) assess*, survey*, questionnaire*, screen*, test*, scale*, measur* or instrument* . This led to 47 papers that were relevant and published in peer reviewed journals, all of which are cited in this review. These papers were supplemented by searches on each instrument.

Insert Tables 1 and 2 about here

2.1. Single item measures

A single item is often used to assess current cravings or urges, usually in terms of frequency or intensity. For example, Drobles & Thomas (1999) asked “How strong is your urge to drink?” and Borg (1983) asked participants to “Please circle the number which most accurately represents how much you currently feel like a drink” (Borg, 1983). If the focus is on the occurrence of craving as a diagnostic feature, the question may focus on strong craving or urges, and have a binary response. More typically, continuous scaling is used (e.g., using Likert or visual analogue scales—VAS; Drobles & Thomas, 1999). These items have several advantages: they are simple to understand; easy and cost-efficient to

administer and score; and they minimise respondent burden and related risks of refusal (Bergkvist & Rossiter, 2007; Sloan, Aaronson, Cappelleri, Fairclough & Varricchio, 2002).

A single-item measure can be highly correlated with longer measures, where both are focused on the current state (Ooterman, Kooeter, Vserheul, Schppers, & van den Brionk, 2006). Such measures are also sensitive to habituation during exposure to alcohol cues (Kavanagh et al., 2006). Cross-sectional administration of these measures can even detect treatment-induced changes (Lawford et al., 1995), but as discussed above, such assessments are subject to the representativeness of that moment. A single assessment in the clinic may not provide a robust prediction of subsequent drinking across substantial periods (Connor, Feeney, & Young, 2005).

The brevity of these instruments make them well suited to repeated assessments in the natural environment, for example using mobile electronic devices (e.g., Lukasiewicz, Benyamina, Reynaud & Falissard, 2005). In that case, they allow assessment of craving trajectory, and potentially of craving just prior to drinking. When repeatedly administered, these measures can be highly predictive of drinking. In a study by Richardson et al. (2008) examining the impact of acamprosate and naltrexone on both craving and drinking levels, single-item ratings of peak daily craving were entered as time-varying covariates of daily alcohol consumption. After entry of depression and alcohol dependence, craving was a highly significant predictor of drinking. Furthermore, it modified the impact of the medications, which only had an impact on drinking when participants had high levels of daily craving. Fedoroff, Sobell, Agrawal, Sobell & Gavin (1999) found that a single item measure of craving was just as effective as a longer, multi-item scale at predicting treatment outcome in a group of mild to moderate alcohol abusers.

2.2 Multiple-item measures of single dimensions

Single-item instruments have greatest utility when the construct is unitary and the item is well understood by raters (Bergkvist & Rossiter, 2007; Sloan et al., 2002). While different single-item measures in the domain of craving are positively correlated, they are not equivalent. Rosenberg and Mazzola's (2007) study of binge-drinking college students, using retrospective 100mm Visual Analogue Scale (VAS) ratings of need, desire, craving urge and compulsion at the most recent time they 'really wanted a drink', demonstrated that respondents do discriminate between these terms. Sampling from across the conceptual domain may capture the phenomenon more fully than will a single item. Measures with multiple items provide greater reassurance that responses are not subject to an idiosyncratic understanding of particular questions, and increases in item numbers (especially over the first 5-10) substantially improve internal consistency (cf. Sayette et al., 2000, Fig. 1, p. S199) because measurement error is reduced by averaging.

2.2.1 Penn Alcohol Craving Scale (PACS)

An example of a single-dimensional, multi-item measure is the 5-item PACS. This scale assesses frequency, intensity and duration of thoughts about drinking, average craving in the past week, and difficulty resisting drinking if a bottle were available, and uses 0-6 response options that vary across items (Flannery, Volpicelli & Pettinatti, 1999). Apart from a final alternative in the last item ('would not be able to resist'—a self-efficacy belief), the PACS clearly meets our definition of craving. It has high internal consistency, predicts relapse (Flannery et al., 1999), and is correlated with the Obsessive Compulsive Drinking Scale (OCDS; Anton, Moak & Latham, 1995) and the Alcohol Urge Questionnaire (AUQ; Bohn et al., 1995). A Korean version also correlated with the OCDS and a single item VAS (Kim et al., 2008). In an intervention trial, Flannery, Poole, Gallop and Volpicelli (2003) found that weekly assessments of craving using the PACS over 9 months significantly predicted drinking

over the subsequent week, after control for alcohol consumption the week before. Similarly, Oslin et al. (2009) used a daily version of the PACS to identify patterns of alcohol craving over an inpatient stay, which predicted time to relapse over the next month.

2.3. Scales based upon obsession and compulsion

Multi-dimensional instruments have the capacity to represent more complex craving models (Sloan et al., 2002). These models work on the assumption that alcohol craving is represented by a number of subsidiary constructs, which are thought to add conceptual, empirical and theoretical strength.

2.3.1 Yale-Brown Obsessive Compulsive Scale – heavy drinkers (Y-BOCS-hd)

The Y-BOCS-hd is based on the premise that alcohol craving and related phenomena are similar to features of obsessive compulsive disorder (OCD; Modell, Glaser, Mountz, Schmaltz, & Cyr, 1992). The original Y-BOCS is a structured clinical interview focussing on obsessionality and compulsivity, and the heavy drinkers form was derived by changing the terms “obsessive thoughts” and “compulsive behaviors” to “ideas, thoughts, impulses, or images related to drinking” and to “drinking alcoholic beverages”, respectively. In the Y-BOCS-hd, obsessionality and compulsivity were each assessed with 4 items rated on a 5-point analogue scale. Items were phrased in the present tense (or as a conditional proposition), with the timeframe left undefined.

Obsessionality items cover time spent thinking about alcohol, interference of alcohol thoughts with other activities, distress associated with alcohol thoughts, resistance against alcohol thoughts, and control over alcohol thoughts. These items correspond to the concept of craving in the current paper. Compulsivity items cover the quantity of alcohol consumed, interference of drinking with work and social roles, distress associated with being prevented from drinking, efforts made to resist drinking, and control over drinking. In Modell et al.

(1992), mean scores for each question and for each subscale were significantly higher in patients with alcohol use disorders than controls. Modell et al. (1992) also demonstrated that both scales were significantly correlated with a single-item subjective craving rating. Connor et al. (2005) observed strong construct validity but a weak, non-significant correlation with the Borg craving scale (Borg, 1983) in an alcohol dependent, treatment seeking sample. In this study, neither the YBOCS-hd or Borg were able to predict number of days abstinence, after controlling for pharmacotherapy. A Turkish version (Ilhan, Demirbas, & Dogan, 2006) discriminated alcohol dependent patients who had been abstinent for less than or more than one month, and a Chinese version (Gau, et al., 2005) discriminated between normal, abusing and dependent drinkers. However, as argued above, while compulsive and problematic drinking is associated with craving, it does not constitute it. This issue also affects later measures that are based on the Y-BOCS.

2.3.2 Obsessive Compulsive Drinking Scale (OCDS)

Anton et al. (1995, 2000) modified the Y-BOCS-hd to develop the self-administered OCDS, which currently is the most widely used alcohol craving scale. Response options were changed to 4 statements ranging from minimal (0) to maximum, and 4 YBOCS items were each split in two, to give a 14-item scale. Item 1 (time spent drinking) was split to separately measure duration and frequency; Item 6 (consumption) was split to measure daily consumption and drinking days per week; Item 7 (interference) was split into work and social situations; and Item 10 (control) was split into drive strength and control. The highest score on the 4 split items contributed to the total subscale score. .

Since publication of the original OCDS, an adolescent version (OCDS-A) has also been developed (Deas, Roberts, Randall & Anton 2001, 2002; Thomas & Deas, 2005), as well as a short form consisting of *Obsessions* and *Compulsions* items (Morgan, Morgenstern,

Blanchard, Labouvie & Bux, 2004; Nakovics, Diehl, Croissant & Mann, 2008). Versions have been evaluated in a number of other languages, including Spanish (Cordero, Solis, Cordero, Torruco, & Cruz-Fuentes, 2009), Italian (Janiri et al., 2004), French (Anseau et al., 2000; Chignon et al., 1998), Dutch (Schipper, De Jong, Lehert, et al., 1997), German (Soyka, Helten & Schmidt, 2010) and Japanese (Tatsuzawa, Yoshimasu, Moriyama, Furusawa & Yoshino, 2002).

The original two-dimensional structure of the OCDS proposed by Anton et al. (1995) was substantially consistent with the one found by Deas et al. (2001, 2002), Nakovics et al. (2008), Cordero et al., 2009). However, other research has not consistently replicated this structure, instead finding three- (Kranzler, Mulgrew, Modesto-Lowe & Burleson, 1999; Roberts, Anton, Latham & Moak, 1999; Janiri et al., 2004; Heinz, Lober, Georgi, et al., 2003), four- (Bohn, Barton & Barron, 1996; Connor, Jack, Feeney, & Young, 2008; Connor, Feeney, Jack & Young, 2010; Nakovics et al., 2008) or even six-factor solutions (De Wildt et al., 2005). Table 3 summarises some of these factor structures.

Insert Table 3 about here

As Table 3 shows, the OCDS shows substantial variability in factor structure across studies, although core items that we regard as craving (especially the thoughts and feelings items 1, 2 and 4) have some stability in their association with obsessionality.

Understandably, Item 3 (functional interference from craving) sometimes loads with items on interference from drinking itself, and difficulty resisting urges (Items 5 and 6) often links with items on behavioral control. Strength of the drive to consume alcohol (Item 11) sometimes loads (or cross-loads) on obsessions (Nakovics et al., 2008; Roberts et al., 1999),

and in one study (Roberts et al., 1999) it is joined by being anxious or upset after being prevented from drinking. However, both typically load most strongly on compulsions or interference from drinking.

OCDS Obsessionality has been able to predict later drinking, especially in the context of short-term predictions that are averaged over a substantial period (e.g., weekly assessments over 9 months, Flannery et al., 2003), where the prediction can be observed even after control for past drinking. Soyka, Helten & Schmidt (2010) found that Obsessionality scores taken immediately after an 8-month abstinence treatment, at 6 month follow-up, and at 12 months were all predictive of an increased likelihood of relapse up to 24 months from discharge. Single assessments of Obsessionality often demonstrate weaker predictive power (Kranzler et al., 1999). The OCDS has been shown to be sensitive to the amount of previous treatment experienced by alcohol dependent individuals (Moak, Anton & Latham, 1998), with those who have had two or more previous attempts at detoxification scoring higher than those with fewer attempts (Malcolm, Herron, Anton, Roberts & Moore, 2000).

2.4. Instruments based upon the Questionnaire of Smoking Urges (QSU)

A series of instruments have been developed from nicotine and cocaine research (Tiffany & Drobes, 1991, Tiffany, Singleton, Haertzen & Henningfield, 1993). Tiffany and Drobes' (1991) 32-item Questionnaire of Smoking Urges (QSU) provides momentary evaluation of cravings for nicotine, based upon Tiffany's (1990) cognitive craving theory. Tiffany (1990) explains craving as a sensation experienced when cognitive control processes or situational factors prevent the execution of an automated action schema for drug use, initially triggered by environmental cues. QSU items focus on present craving and conceptualise craving in terms of 4 domains: desire to smoke; anticipation of positive

outcome; relief from withdrawal or negative affect; and intention to use cigarettes. EFA produced a 2-factor solution (Tiffany & Drobes, 1991) with Factor 1 (15 items) associated with anticipation of pleasure, enjoyment and satisfaction from smoking, and Factor 2 (11 items) associated with anticipation of relief from negative affect and withdrawal and intense desire to smoke, although the factors were intentionally not given interpretive labels.

2.4.1 Questionnaire of Alcohol Urges (QAU) and Alcohol Urge Questionnaire (AUQ)

Bohn et al. (1995) derived items related to alcohol craving by adapting QSU items to alcohol, and adding statements on desire, intentions, anticipated effects and expected control, based on a review of the craving literature. Like the QSU, the alcohol questionnaire (QAU) focuses on the present moment ('right now', 'this minute'), and uses a 7-point Likert scale reporting the extent of agreement or disagreement.

In contrast to the 2-factor structure of the QSU, Bohn et al.'s (1995) EFA and CFA on the alcohol items revealed a single-factor solution. With the aim of producing a shorter scale more conducive to multiple administrations, eight items with the highest factor loadings were selected to form the AUQ. However, to do this the scale retained only one item directly assessing craving, and included seven others concerning need to drink, expected positive outcomes, difficulty of drink refusal, and likely behavior. These items violate the definition of craving being used in this review, and would lead to inflated predictions of later drinking. Indeed, the AUQ correlates positively with OCDS total and severity of dependence (Bohn et al., 1995; Drummond & Phillips, 2002), and shows sensitivity to cue exposure (MacKillop, 2006). Weekly assessments over 9 months of treatment predicted the following week's drinking, after control for drinking the previous week (Flannery et al., 2003).

However, because most of items were based upon factors other than craving, it is difficult to draw any conclusions about the utility of single craving item.

2.4.2 Alcohol Craving Questionnaire (ACQ) and Desires for Alcohol Questionnaire (DAQ)

Two other instruments used Tiffany and Drobles' QSU as their basis: The 47 item ACQ (Singleton, Tiffany & Henningfield, 1994) and the 36 item DAQ (Clark et al., 1996; cited in Love, James & Willner, 1998). Both scales reportedly included additional items intended to produce better coverage of the craving domain than that provided by a unifactorial measure, and the DAQ also rephrased negatively scored items so that all items were answered positively. The ACQ was intended to include five subscales (urges and desires, intent to use, positive anticipation, anticipation of relief from withdrawal, and lack of control) but produced 4 factors labelled *emotionality*, *purposefulness*, *compulsivity* and *expectancy* in Singleton et al. (1995, cited by Connolly, Coffey, Baschnagel, Drobles & Saladin, 2009), 3 factors—*strong desires and intentions to drink alcohol*, *no desire to drink*, and *negative and positive reinforcement* in Love et al. (1998), and 2 factors—*urge and intention to use alcohol*, and *reinforcement* in the EFA and CFA by Raabe, Grüsser, Wessa, Podschus, and Flor (2005). Each of these studies found that many of the original 47 ACQ items (17 items, 23 items and 17 items respectively) did not load on any of the extracted factors. As the name suggests, the first factor of each version confounded intentions and urges. The second factor of Raabe et al. (2005) assessed the nature of current, activated expectancies. Substantial positive correlations of both factors with OCDS obsessions and urges were found by Raabe et al. (2005).

Love et al. (1998) also evaluated a shorter 14-item version of the DAQ, which showed a 4-factor structure (*reinforcement*, *strong desires*, *weak desires*, *control over*

drinking) in an alcohol dependent sample. A more recent study of the 14-item DAQ used a 5-point response scale and items that focussed upon past drinking rather than a current craving state (Kramer et al., 2010). Within 1,500 subjects with an alcohol use disorder (AUD) and 1,460 controls, principal components analysis produced 3 factors: *Strong Desires/Intentions to Drink*, *Negative Reinforcement*, and *Positive Reinforcement /Ability to Control Drinking*. These factors were stable across both clinical and non-clinical samples. As in Love et al. (1998), an independent control factor did not emerge. Total DAQ scores for the two groups were significantly different, and correlations between the DAQ, a 10-item measure of alcohol symptoms and a single craving item were higher for the AUD group. Schulze & Jones (2000) found that 14-item DAQ scores were higher for a group of students exposed to a 'taste preference' test using alcoholic drinks, compared to a group who tasted soft drinks.

2.4.3 Summary of measures based on the QSU

In this family of measures based on the QSU, craving is confounded with intentions and with likely control of drinking—an issue that is likely to inflate predictions of drinking over effects of craving alone. All 4 measures have factor structures oriented around desire and pleasure, reinforcement, and control over drinking. The number of factors varies from 1 (with the AUQ) to 4. While Love et al. (1998) argued that the DAQ produced a more coherent factor structure than the ACQ and discriminated better between heavy and more moderate drinking groups, more data are needed before one scale emerges as superior.

2.5. Approach and Avoidance of Alcohol Questionnaire (AAAQ)

Development of the AAAQ (McEvoy et al., 2004), unlike the previous measures, was based on an ambivalence or conflict model, which proposes that craving episodes typically involve independent and competing processes of avoidance (resisting alcohol) and approach

(wanting alcohol). It therefore taps into ambivalence towards drinking, rather than only targeting desires for alcohol. The AAAQ originally focused on the previous week, although a 24-hour version or even a session segment may be targeted (Klein, Stasiewicz, Koutsky, Bradizza, & Coffey, 2007). Items assessing the tendency *to* drink (approach) or *not* drink (avoidance) are rated using a 9-point scale (*not at all* to *very*). The authors of the AAAQ argued that the structure was compatible with neuroanatomical models distinguishing separate pathways for behavioral activation and inhibition (e.g., Anton, 1999; Breiner, Stritzke & Lang, 1999). They also hypothesized that the approach pathways might lead to 2 components, one linked to mild inclinations to drink and another linked to stronger, obsessive-compulsive components (as in the OCDS). Two studies of the 20-item AAAQ were conducted, the first with Australian students and the second with US students (almost all of whom were below the legal drinking age). In the first study, principal axis factor analysis identified an unstable 4-factor solution. Reducing the items to 13 provided a 3-factor solution: indicating mild inclinations to drink, inclinations to avoid alcohol, and intense inclinations to drink. In the second study, which reinstated 1 of the 7 excluded items after rephrasing, CFA confirmed the 3-factor solution.

Subsequent evaluation of the psychometric properties of the AAAQ using all 20 items with an alcohol dependent sample (Klein et al., 2007) produced a 2-factor solution; *Approach* and *Avoidance*, with the mild and strong inclination to drink factors combining. The factor structure was confirmed through a CFA conducted upon the same sample at a second testing session. *Approach* was associated with heavier and more frequent drinking, positive and negative expectancies, and with cue reactivity; *avoidance* was associated with less frequent drinking, readiness to change measures, and negative expectancies. Both factors were associated with measures of dependence.

As discussed above, we recognise that avoidance motivations are potentially of substantial practical and theoretical importance, but argue that they do not constitute craving for alcohol (instead, comprising competing desires). Within the Approach factor, 4 of the original 10 items appear to lie outside our strict definition of craving ('thinking of ways to get alcohol', 'planned to drink', 'would have accepted', 'would have had a drink'; cf. Table 1). While thoughts about acquisition of alcohol are likely during episodes of craving, inclusion of these items was likely to inflate predictions of subsequent drinking beyond those from craving alone.

2.6. Jellinek Craving Questionnaire (JACQ)

The authors of the JACQ (Ooteman et al., 2006) derived 129 items based on craving being 'the frequency [or] intensity of a conscious experience consisting of feelings of urge, physical sensations, actual temptation [or] uncontrolled thoughts towards drinking alcohol in a general [or] instant time frame" (p. 59). These items were reduced to 24 in 4 equal subsets: urges, physical sensations, temptation for drinking, and uncontrolled re-occurring thoughts, and responses were scored using a 1-5 scale from 'not at all' to 'very much'. Two time frames have been tested: JACQ-now, and JACQ-past, where the latter involved imagining alcohol being present during the past period when the respondent was regularly drinking. Review of item content against the distinctions above revealed two predictions of loss of control ('I would drink immediately if I saw or smell alcohol'; 'I would not be able to stop if I would taste a little alcohol') and most psychophysiological responses had potential for multiple determinants (e.g., 'My heart would beat faster...' 'I would sweat more than usual...'), but urges, most temptations, and uncontrolled thoughts meet our face validity criteria for craving. While exploratory simultaneous components analyses with alcohol dependent patients produced four components for both JASQ-now and JACQ-past, further

analyses using principal components suggested that a single dimension may better describe both versions (Ooterman et al., 2006).

Convergent validity for JACQ-now after cue exposure was shown by strong correlations with the ACQ, current stress, a single-item VAS rating of craving, moderate correlations with OCDS obsessions (Items 1, 2, 4, 13) and heart rate. JACQ-past had high 3-week test-retest reliability and high correlations with the Alcohol Use Disorders Identification Test (AUDIT, Saunders, Aasland, Babor, de la Fuente, & Grant, 1993) and a moderate correlation with change in peak cortisol after cue exposure, but was poorly correlated with the OCDS and current craving. JACQ-now was also poorly correlated with JACQ-past, which perhaps illustrates the risks of attempting to reconstruct craving in a hypothetical exposure context.

2.7. Alcohol Craving Experience Questionnaire (ACE).

Development of the ACE (Kavanagh, May & Andrade, 2009; Statham, et al., 2011) was underpinned by the Elaborated Intrusion (EI) theory of desire, which proposes that craving is an emotional-cognitive phenomenon that consists of an initial, apparently spontaneous intrusive thought followed by a process of cognitive elaboration, including sensory imagery (Kavanagh et al., 2005; May, Andrade, Panabokke, & Kavanagh, 2004). These images are initially experienced as pleasurable, but in the absence of alcohol they become aversive. Craving imagery loads working memory and, because of the limited capacity of working memory, this load interferes with the ability to perform other cognitive tasks and so the craving experiences dominate. The ACE assesses intrusive and elaborative craving cognitions, as well as imagery. To avoid the problems associated with respondents either averaging their craving over time or choosing atypical craving episodes, the ACE includes related items addressing two distinct sets of craving events: the intensity of

experiences during the strongest recent episode of alcohol craving (ACE-S) and the frequency of recent desires and urges (ACE-F). Subsets of items were developed to address intense cravings, involvement of sensory imagery, and intrusiveness of desire-related thoughts. All items meet the current criteria for craving and clearly addresses the idea of craving as an episodic state; however, only frequency and intensity of episodes are targeted, and not duration.

Statham et al. (2011) administered the ACE-S and ACE-F to alcohol dependent outpatients and people with an alcohol use disorder in a treatment trial. EFA confirmed the 3 separate factors for both Strength and Frequency forms, with high internal consistency for each factor. CFA with an independent clinical sample confirmed the 3-factor structure after modification. Diagnostic validity was demonstrated by comparing a student sample with the clinical sample. Both ACE-S and ACE-F discriminated between non-dependent and possibly dependent participants and between non-clinical and clinical participants. Both correlated positively with OCDS subscales and with measures of distress. ACE-F and the Intrusion subscale of ACE-S were significantly correlated with the Alcohol Use Disorders Identification Test (AUDIT). Predictive validity data on the current ACE have not yet been published and therefore a key measurement criterion is not met at this time.

3. Discussion

Conceptual confusion about craving has resulted in most measures being confounded with similar but separable elements such as intentions, plans, self-efficacy or arousal. While these may often co-occur in craving episodes and have importance in their own right as predictors of later drinking, their inclusion as elements of craving itself is problematic. The presence of these extraneous elements is likely to inflate estimates of the

predictive power of craving and impair our ability to understand and treat the phenomenon. In some cases, a focus on a subscale or on selected items may provide a measure that meets our criteria (e.g., OCDS Obsessions). Other measures that conform to our definition of craving include the ACE, PACS and single-item VASs on craving or urge intensity.

Measures of both approach and avoidance of alcohol more completely map the complex motivational space in which drinking decisions are made, than an assessment of one element. Refinement of measures that capture both desires for alcohol and for its control may have substantial practical importance by allowing clinicians and researchers to assess the strength of motivations that support and undermine alcohol control. However, only one side of the approach-avoidance balance is about alcohol craving *per se*.

The measures reviewed in this paper have several limitations other than their content focus. Some ask for summaries of past craving (e.g., weekly versions of PACS or AAAQ), which introduce effects of memory biases, especially when the phenomenon changes in frequency and intensity. The Y-BOCS and OCDS have an indeterminate focal period—using present tense, but implying repeated observation (e.g., ‘How much time...’ or ‘How frequently...’). This lack of specification is likely to introduce variability in the periods used by different respondents, and introduces a subtle form of summarising potentially different experiences. The ACE avoids retrospective averaging, by focusing on a recent intense experience and on perceived frequencies of craving or urges. It remains to be seen whether this strategy reduces the impact of memory biases and is more predictive of future consumption and functioning.

The type of response required by a measure is also important. Measures that ask for extent of agreement to a statement (e.g., DAQ, AUQ) include items that are phrased at particular intensity levels (e.g., ‘overwhelming’). Lack of agreement to a high-intensity item

offers limited information on whether less intense desires are being experienced. This is particularly relevant where reductions in desire intensity form a focus for intervention. Responses should preferably rate degree of intensity or frequency (as in PACS, OCDS Obsessions, ACE) rather than agreement.

Our overall argument throughout the current paper may be characterised as one for a single, coherent concept. For example, we have drawn attention to the fact that obsessive thoughts about alcohol in the OCDS (especially Items 1, 2 and 4) tend to cohere well. However, such a focus has limitations. The core set of items only captures aspects of frequency, duration and associated distress or disturbance—omitting (for example) the important characteristic of intensity (Item 13). A narrow definition of craving does not exclude a potential for multifactorial structure. Psychometric data suggest that the definition of craving applied in this review may be separated into sub-factors (e.g., intensity, degree of intrusiveness or functional interference, difficulty in resisting urges, sensory elements), although these correlate with each other (e.g., with vivid sensory experiences being most prominent in more intense episodes; Statham et al., 2011). There are likely to be benefits in delineating different aspects of craving, as current data suggest that they may differ in their predictive utility or offer contrasting treatment targets. Their separation may also help to identify aspects of the quality or content of episodes that help to drive the affective response or make craving seem particularly irresistible.

Cross-sectional measures of current cravings and urges have several advantages. They avoid memory biases, although they do not completely avoid attentional or attributional bias (e.g. attributing drinking to intense craving). If administered immediately prior to the predicted event (e.g. drinking, reduced self-efficacy, interference with other tasks), they may optimise estimates of the true predictive power of craving. However, while

proximal measurement is possible in the clinic or laboratory, it is less easy in the natural environment. It is impractical to continuously monitor craving over extended periods, and random momentary sampling may miss critical episodes. Furthermore, while continuous assessments can offer estimates of frequency, single cross-sectional measures do not. It is here that retrospective measures of frequency or duration (e.g. OCDS Items 1, 2; PACS Items 1, 3; ACE-F) have an advantage. This feature was probably responsible for Flannery et al.'s (2003) finding that repeated assessments of the one-week PACS and OCDS-Obsessions were stronger predictors of the next week's drinking than were present-focused AUQs. A compromise is to obtain daily reports of peak intensity, duration and frequency, supplemented by assessments in contexts of high risk (e.g. before dinner; at a sporting fixture). Multiple daily ratings can then be used to derive averages, or (better still) provide a time-varying predictor of daily drinking risk (Richardson, et al., 2008).

Ecological Momentary Assessments using mobile phones provide exciting possibilities in providing prompts and summaries to users, as well as automatically linking craving to specific times and locations. Multiple cross-sectional recordings also allow the creation of trend lines. Research by Shiffman and colleagues (1997) on daily smoking urges showed that lapses may be preceded by linear increases in craving over successive days. We have seen no equivalent study on alcohol craving, but if that occurred, it would have important theoretical and practical implications. Progressive increases in peak daily craving or high frequencies of intrusive thoughts about drinking may produce challenges for maintaining efforts to resist drinking. If so, alerting people to rising risk may give an opportunity for those people to use additional control strategies, or seek help from others.

There are two key requirements for frequently repeated measures. If we are to obtain high levels of adherence without substantial added inducements, monitoring is best

restricted to short periods of time (e.g., during withdrawal or other periods of high risk), and to minimal item numbers. Repeated measurement may increase the salience of craving and produce at least short-term reactivity (either increasing risk, or inducing attempts to divert attention and control behavior; Sayette et al., 2000). However, reactivity is probably less problematic with intense craving, which floods attention and demands coping strategies regardless of monitoring.

4 Conclusions

As yet, no single instrument is approaching a gold standard. We argue that a definition along the lines of the one in this paper is needed, in order to drive the development of such a measure. Only when agreement is obtained on the key conceptual issues can we derive a greater sophistication in our theoretical and empirical understanding of craving, and better understand the true place it has in problematic drinking and its treatment. We suggest that an optimal assessment strategy is likely to involve measures of craving or urges at least daily, and during situations of high risk for drinking or for functional impact from craving.

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Acknowledgements

Preparation of this paper was supported by a National Health and Medical Research Council of Australia Career Development Fellowship held by Jason Connor.

Table 1. Features from the current definition of craving that appear to be addressed in existing alcohol craving measures¹

Measure	Period assessed	Frequency	Duration of episodes	Intensity	Salience/Dismissability	Functional impact or distress from craving	Extraneous phenomena
Single item intensity ratings	Typically current	--	--	✓	--	--	--
PACS	Past week/ Today versions	✓	✓	✓	--	--	Self-efficacy (One response alternative only)
Y-BOCS-hd	Present tense (unspecified)	*	*	--	✓	✓	Past behaviour: consumption; effort to resist drinking Functional impact/distress about drinking Perceived control of drinking
OCDS	Present tense (unspecified)	✓	✓	✓	✓	✓	Past behaviour: consumption; effort to resist drinking Functional impact/distress about drinking Perceived control of drinking
QAU, AUQ, ACQ, DAQ	Current	--	--	✓	--	--	Intentions Perceived Control of drinking
AAAAQ	Past week	✓	--	✓	--	--	Past behavior: control of drinking; avoidance of risk situations Planning alcohol acquisition/drinking Cognitive strategies to avoid drinking Negative expectancies/desire to avoid drinking
JACQ	Current	--	--	✓	✓		Perceived control of drinking Physiological arousal**
ACE-S	When most wanted a drink in last week	--	--	✓	✓	--	--
-F	Past week	✓	--	✓	✓	--	--

1. Based on a comparison of item content with the definition of craving in this paper.

*Item 1 of the Y-BOCS-hd confounds frequency and duration. Item 10 initially asks about strength, but the responses focus on degree of control over consumption. The OCDS addresses these problems by separating the items.

**Physiological arousal (e.g. increased heart rate when smelling or seeing alcohol) may be related to craving, but may also occur for other reasons (e.g. anxiety about loss of control).

PACS: Penn Alcohol Craving Scale; Y-BOCS-hd: Yale-Brown Obsessive Compulsive Scale – heavy drinkers; OCDS: Obsessive Compulsive Drinking Scale; QAU: Questionnaire of Alcohol Urges; AUQ: Alcohol Urge Questionnaire; ACQ: Alcohol Craving Questionnaire; DAQ: Desires for Alcohol Questionnaire; AAAQ: Approach and Avoidance of Alcohol Questionnaire; JACQ: Jellinek Craving Questionnaire; ACE: Alcohol Craving Experience Questionnaire.

Table 2. Studies Exploring the Reliability, Construct and Concurrent Validity of Craving Measures

Measure (# Items)	Authors	N	Participants	Alcohol Dependence	Reliability [✓]	Construct Validity (EFA)	EFA Type, Rotation		Construct Validity (CFA)	Convergent Validity	Concurrent Validity	
							Factors (# Items)	Labels				Factors
PACS (5)	Flannery et al. 1999	147	Naltrexone/ Psychotherapy Trial	DSM-III-R	ICC	1	—	—	—	OCDs; AUQ	Relapsed/ Not relapsed	
Y-BOCS-hd (10)	Modell et al. 1992	124	Inpatients Controls	DSM-III-R AB or AD	—	—	—	—	—	Single item scale	Inpatients/ Controls	
OCDs (14)	Anton et al. 1995	60	Inpatients	DSM-III-R	ICC TR (n=18)	—	—	—	—	Y-BOCS-hd (with Inter-rater reliability)	—	
	Anton et al. 1996	41	Outpatients	DSM-III-R	—	—	—	—	—	3 x Single-item craving measures; ADS; ASI	—	
	Bohn et al. 1996	256	Detoxification Inpatients Outpatients Half-way houses	ADS for alcohol use severity; DAST-10	ICC	4	(4) Obsessions (2) Consumption (5) Automaticity (3) Interference	Principal components; Principal axis (Rotation not reported)	4	As for EFA	ADS; IDS; Consumption Self-efficacy; Coping style; number of detoxifications	—
	Kranzler et al. 1999	127	Community sample	DSM-III-R	ICC	3	(6) Obsessions (5) Control, Consequences (3) Consumption	Principal components Orthogonal	—	—	ADS; ASI; Single-item scale; TLFB	Abstinence/Slip/ Relapse
	Roberts et al. 1999	132	AD Outpatients	DSM-III-R	ICC	3	(6) Resistance/ Control impairment (5) Obsession (3) Interference (5) Compulsions (4) Interference (3) Obsessions (2) Resisting Obsessions	Principal axis Promax	—	—	ADS; ASI	Abstinence/Slip/ Relapse
	Connor et al. 2008	370	Outpatients	DSM AUDIT	ICC	4	(5) Compulsions (4) Interference (3) Obsessions (2) Resisting Obsessions	Principal Axis Oblimin	4	As for EFA	AUDIT; Consumption (TLFB)	—
	Connor et al. 2010	309 370	Students AD Outpatients	AUDIT	ICC	4	(5) Interference/ Control (2) Frequency of obsessions (2) Alcohol consumption (5) Resisting obsessions & compulsions	Principal Axis Oblimin	4	As for EFA	AUDIT, OCDs, Consumption	Clinical/ Nonclinical Students/ patients

Measure (Items)	Authors	N	Participants	Alcohol Dependence	Reliability [✓]	Construct Validity (EFA)		Concurrent Validity				
						Factors (#Items)	Labels					
ACQ (30)	Raabe et al. (2005)	243	Alcohol use disorder patients	DSM-IV	ICC TR	2	(21) Urge and intention to drink (9) -/+ reinforcement	(Unstated) Varimax	2	As for EFA	OCDS	—
DAQ (36) ^a	Love et al. 1998	380	Recreational drinkers	Not assessed	ICC	3	(12) -/+ reinforcement (11) Strong desires & intentions (5) Mild desires & intentions	Principal components Oblimin	—	—	—	Binge/ Non-binge Excessive/ Moderate
DAQ (14) [#]	Love et al. 1998	131	In treatment/ Alcoholics Anonymous	Not assessed	—	4	(4) - reinforcement (6) Strong desires & intentions (2) Mild desires (2) Control	Principal components Oblimin	—	—	—	—
JACQ (24)	Ooteman et al. 2006	251	Inpatients	DSM-IV	ICC TR (JACQ-past, n=34)	1	4 components: Emotional urge Physical sensations Temptation to drink Uncontrollable thoughts	Simultaneous Components	—	—	AUDIT; ACQ-now; OCDS; Single-item craving; STAI; MAACL BMIQ; Physiological & Endocrine measures	—
AAAQ (20; 13; 14)	McEvoy et al. 2004	589	Students	Not assessed	ICC	3	Inclined/Indulgent * Resolved/Regulated * Obsessed/Compelled * thoughts	Principal axis (oblique)	3	As for EFA	YAAPST; SOCRATES Quantity Frequency	—
AAAQ (20)	Klein et al. 2007	138	Outpatients	DSM-IV	ICC	2	(10) Approach (10) Avoidance	Principal axis (oblique)	2	As for EFA	TIFB, AEQ, SOCRATES, ADS, Cue Reactivity (Alcohol Attention Scale, DrInC, Craving self-report (0-10 want, crave, desire), saliva)	—
ACE (22)	Statham et al. 2011	449	Outpatients; RCT participants; Students	AUDIT	ICC	ACE-S:3 (4) Intensity (5) Imagery (2) Intrusion ADE-F:3 (4) Intensity (5) Imagery (2) Intrusion	Principal Axis Oblimin	4	As for EFA	AUDIT, OCDS, DASS	Clinical/ Nonclinical; Students/ patients	

^ ICC: Internal consistency coefficient. TR: Test-retest reliability. All coefficients > .70 unless otherwise stated.

* Number of items loading on each factor were not reported.

Number of items in the original questionnaire

AAAQ = Approach and Avoidance of Alcohol Questionnaire, ACE = Alcohol Craving Experience Questionnaire, ACF-3F = Alcohol Craving Scale Based on 3 Factors, ACQ = Alcohol Craving Questionnaire, ACQ-now = Alcohol Craving Questionnaire-now, ADS = Alcohol Dependence Scale, ASI = Addiction Severity Index, A-OCDS = Adolescent Obsessive Compulsive Drinking Scale, AUDIT = Alcohol Use Disorders Identification Test, AUQ = Alcohol Urge Questionnaire, BAC = Blood Alcohol Concentration, BIS-10 = Barratt Impulsiveness Scale, BMIQ = Betts Mental Imagery Questionnaire, CORE = Core Alcohol and Drug Survey, DASS = Depression, Anxiety and Stress Scale, DAST-10 = Drug Abuse Screening Test, DAQ = Desires for Alcohol Questionnaire, DSM = Diagnostic and Statistical Manual, EPQ = Eysenck Personality Questionnaire, ICD-10 = International Classification of Diseases, Version 10, JACQ = Jellinek Craving Questionnaire MAQL = Mood Adjective Checklist, OCDS = Obsessive Compulsive Drinking Scale, OCDS-G = OCDS = Obsessive Compulsive Drinking Scale-German, PACS = Penn Alcohol Craving Scale, QAU = Questionnaire of Alcohol Urges, SADDQ = Severity of Alcohol Dependence Questionnaire, SADS = Severity of Alcohol Dependence Scale, SPSRQ = Sensitivity to Punishment and Sensitivity to Reward Questionnaire, SOCRATES = Stages of Change Readiness and Treatment Eagerness Scale, STAI = State Trait Anxiety Inventory, TLFB = Time Line Follow Back, YAAPST = Young Adult Alcohol Problems Screening Test, Y-BOCS-hd = Yale-Brown Obsessive Compulsive Scale – heavy drinkers.

Table 3. OCDS items and factor structures across studies

OCDS Item	Bohn et al., (1996)	Kranzler et al., (1999)	Roberts et al., (1999)	Connor et al., (2008)	Nakovics et al., (2008)
1 How much of your time...is occupied by ideas, thoughts, impulses or images related to drinking	DO	O	O	O	O
2 How frequently these thoughts occur	DO	O	O	O	O
3 How much these ideas etc. interfere with ...functioning	DO	O	I	I	O
4 How much distress or disturbance these ideas etc. cause you	DO	O	O	O	O
5 How successful ...in stopping or diverting these thoughts...	AD	O	R	RO	O
6 How much of an effort do you make to resist these thoughts or try to disregard...	AD	O	R	RO	O
7 How many drinks each day	AC	AC	R	C	-
8 How many days drinking	AC	AC	R	C	-
9 How much does your drinking interfere with your work functioning...	ID	CC	I	I	C
10 How much does your drinking interfere with your social functioning...	ID	CC	I	I	C
11 If prevented from drinking... how anxious or upset...	ID	CC	O	I	C
12 How much of an effort...to resist consumption...	AD	AC	R	C	C
13 How strong is the drive to consume...	AD	CC	O	C	C
14 How much control do you have over the drinking	AD	CC	R	C	C

DO = Drinking Obsessions, AC = Alcohol Consumption; AD= Automaticity of Drinking; ID= Interference Due to Drinking; O = Obsession/s; CC = Control and Consequences; R = Resistance/control Impairment; I= Interference; C= Compulsions; RO = Resisting Obsessions