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Craving Typology Questionnaire (CTQ): A scale for alcohol craving in normal controls and alcoholics

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Abstract

Introduction: Craving is commonly thought to play a crucial role both in the transition from controlled drinking to alcohol dependence and in the mechanism underlying relapse. However there is no consensus on its definition, and on its correct assessment. Another significant hindrance is that craving is almost certainly a multi-faceted construct. To this respect a three pathway psychobiological model able to differentiate craving into a reward, relief, and obsessive component has been suggested.
Methods: CTQ was administered to 547 control subjects and to 100 alcohol dependent patients. The dimensional structure of the questionnaire, through the principal component analysis, the reliability and the threshold values were evaluated in both the control and clinical sample.
Results: The results showed and confirmed that the CTQ is composed of three dimensions. Cronbach's alpha coefficients suggest that the questionnaire is reliable. Alcohol-dependent subjects had a significantly higher mean score as compared to the normative sample in both Reward, Relief, Obsessive craving. Younger age correlated with higher scores on Reward craving ($r = 0.38$; $p < 0.001$) and males reported significantly higher scores than women on Reward craving ($t = 4.36$; $p < 0.001$).
Discussion: CTQ showed to be a reliable and valid questionnaire to distinguish a normative sample from pathological individuals. The average scores obtained represent the first normative data available for this questionnaire. Identifying a craving type may represent an important predicting or matching variable for anti-craving psychotropics. More research is needed with respect to CTQ's external validity, i.e. correlations with phenotypic, endophenotypic and genetic indicators of relief, reward and obsessive drinking.

1. Introduction

Alcohol dependence is defined by criteria such as tolerance development, withdrawal symptoms, reduced control over alcohol intake and craving [1,2]. Craving, namely the urge to use alcohol, is present in 54% to 72% of alcohol-dependent subjects [3,4]. The development of craving is commonly thought to play a crucial role both in the transition from controlled drinking to alcohol dependence [5] and in the mechanism underlying relapse [6,7]. Alcohol craving, especially when occurring at treatment onset, is, in fact, associated with relapse during the first phase of treatment [7–10].

Though craving is a phenomenon of clear clinical relevance, there is no consensus on its definition, on the clinical factors influencing it and on its correct assessment [11].

Alcohol craving can be elicited by exposure to alcohol and alcohol-associated stimuli in abstinent alcoholics [12,13]. Internal cues may include emotional states (e.g., anxiety) or symptoms of acute alcohol withdrawal. External

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cues may include exposure to alcohol-related environments or objects (e.g., bottles of alcoholic beverages or advertisements).

Several issues in the field of craving research remain unresolved. Results are often difficult to interpret as the subjective nature of craving makes it hard to assess and quantify it. Also, the quality and intensity of craving may vary depending on personal characteristics as well as environmental circumstances or experimental conditions. Another significant hindrance is that craving is almost certainly a multi-faceted construct.

To this respect, Verheul et al. [14] suggested a three pathway psychobiological model for craving. The first pathway is referred to as *reward craving*, namely the desire for the rewarding, stimulating and/or enhancing effects of alcohol. This type of craving is more common in early-onset male alcoholics, and can be associated with novelty/sensation seeking, impulsivity, anger and traits typically observed in Cluster B Personality Disorders. It might result from either dopaminergic/opioidergic dysregulation or a personality style characterized by reward/sensation seeking, or a combination of both. The term 'reward drinking' is generally associated with positive reinforcement, which can be defined as the presentation of a reinforcing stimulus immediately following a performance. According to this definition, the stimulus may be represented by a positive emotion following alcohol drinking (reward drinking). This pathway has an important genetic load.

The second pathway, *relief craving*, or desire for the reduction of tension or arousal, might result from either γ-aminobutyric acid (GABA) ergic/glutamatergic dysregulation or a personality style characterized by stress reactivity, or a combination of both. In general, the term 'relief drinking' is associated with negative reinforcement, by which we mean the termination of an aversive stimulus immediately following a performance. According to this definition, the stimulus may be represented by a negative emotion (e.g. stress or anxiety) that is terminated by drinking alcohol (relief drinking) [15]. This pathway is usually observed in late-onset alcoholics, mostly females, and is associated with traits typically observed in Cluster C Personality Disorders. The influence of external factors is stronger than the genetic influence.

The third pathway, *obsessive craving*, can be defined as lack of control over intrusive thoughts about drinking resulting in impaired functioning. This type of craving might result either from a serotonin deficiency or a personality style characterized by low constraint or disinhibition, or a combination of both.

These three craving types usually overlap in alcoholics, although the predominance of one dimension can usually be observed in treatment-seeking alcoholics.

The assessment of craving in all its aspects is crucial and might have important implications for the development of differential treatment options. However, the use of a wide range of scales and questionnaires of dubious reliability and validity [16] complicates the understanding of this phenomenon and reflects the lack of a comprehensive aetiological model that explicitly distinguishes correlates and core components.

In some studies, craving is evaluated with a visual analogue scale (VAS) [17]. In this approach, the patient places a mark on a line that is approximately 4 inches long and divided into arbitrary units beginning with zero. The reliability of single-item craving assessments is variable. Multi-item questionnaires include the Obsessive Compulsive Drinking Scale [18,19], which comprises 14 questions, each of which is rated on a scale from 0 to 4, and the Alcohol Urge Questionnaire, which consists of 8 statements rated from 1 to 7 [20]. Potential candidates for a multidimensional measurement of craving include the Alcohol Craving Questionnaire (ACQ) [21] and the Desires for Alcohol Questionnaire (DAQ) [22].

Another attempt to measure craving based on the Elaborated Intrusion Theory of Desire has led to create The Alcohol Craving Experience questionnaire (ACE). This instrument was developed to measure sensory aspects of craving (imagining taste, smell or sensations of drinking) as well as intrusive cognitions associated with craving. It also establishes when craving was maximal during the previous week and assesses frequency of desire-related thoughts in the past week [23]. However, these questionnaires do not explore the different aspects of craving as distinct and independent features.

Ooteman et al. [24] first tried to differentiate craving into different types. The authors developed a new two-dimensional model of relief and reward motives for alcoholics, based on the circumplex model of emotion [25,26] and on Cooper's motivational model of alcohol use [27]. The Amsterdam Motives for Drinking Scale (AMDS) proved to be a reliable questionnaire to measure different types of drinking motives, but it was not able to distinguish between relief and reward drinkers in a population of treatment-seeking alcoholics. Therefore, it seems that the AMDS has limited value in the process of patient-treatment matching.

Craving is sometimes assessed by measuring certain physiological changes thought to accompany it, such as changes in heart rate, blood pressure, salivation and sweat gland activity. However, these parameters are influenced by too many confounding factors to be representative of craving itself.

Our study aims to validate a psychometric instrument called Craving Typologies Questionnaire (CTQ). We tested the hypothesis that this questionnaire is able to differentiate craving into reward, relief and obsessive craving and rate the intensity of each craving type. In order to validate the questionnaire, we decided to use a normative sample. More in detail, the objectives of the present study are:

1. exploring the dimensional structure of the questionnaire, through the principal component analysis;
2. confirming the dimensional structure through structural equation modeling;
3. checking the reliability of the dimensions;

4. identifying the threshold values to use the CTQ for diagnostic purposes.

Moreover, we recruited the sample of alcohol-dependent subjects from two different alcoholism treatment centers in Italy (Rome, Senigallia (AN)) in order to investigate the psychometric properties of the CTQ in a clinical sample and to compare results to the normative data.

2. Methods

2.1. Participants

CTQ was administered to 547 control subjects (47.5% males and 52.5% females); the average age of controls was 35 years (S.D. = 13.68). The group is a normative sample recruited in universities, social areas, commercial venues and public offices in the cities of Rome, Viterbo, Chieti and Pescara. The only inclusion criterion was Italian citizenship. However, individuals with specific cognitive disorders, severe neurological or medical disorders impairing evaluation, weakened physical state, impairment in reality testing and/or a current or past alcohol/substance use disorder (except of tobacco use) were excluded from the study. The control group should be considered a convenience sample and not a probabilistic one [28].

The clinical sample was recruited at the alcoholism treatment unit of the Day Hospital of Psychiatry and Drug Dependence of the University General Hospital "A. Gemelli" in Rome and at the outpatients alcoholism unit "Villa Silvia" in Senigallia (AN). Participants' average age was 49 years (S.D. = 12.07). One-hundred-seventy-five treatment-seeking subjects were evaluated as to DSM-IV-TR (APA, 2000) criteria for Alcohol Dependence. One-hundred subjects fulfilled the diagnostic criteria for Alcohol Dependence (31% males and 69% females). The condition of any drug use, except of tobacco, was an exclusion criterion. Individuals with a current or past substance use disorder, except of tobacco use, were excluded from the study. Patients in clear alcohol intoxication or withdrawal were not assessed. This aspect was evaluated by trained psychiatrists.

2.2. Procedure and questionnaire

First, we reviewed currently published literature and instruments on drinking motives, drinking expectancies, drinking situations and anticipations of drinking outcome. Subsequently, we devised the items based on findings from previous studies carried out by our group [19,29,30] and on the theoretical model postulated by Verheul et al. [14] as to the categories of reward, relief and obsessive craving. A pool of 45 items was created. These items were then appraised by our research group in terms of clarity, lack of ambiguity, simplicity, formulation, generalization and overlap. This phase brought to the elimination of 25 items. We thus obtained a questionnaire composed of 20, five-point, Likert-type items, ranging from 1 (completely false) to 5 (completely true).

The administration of the questionnaire was conducted between March and December 2011.

The questionnaire was presented to participants after providing some basic information on the aim of the research, that is exploring their opinions and perceptions and not assessing their knowledge. Participants were given 15 minutes to complete the questionnaire on their own.

We then developed a database to store gathered data and analyzed it, commenting on the results also in the light of previous research carried out on the same matter, both nationally and internationally.

Anonymity was guaranteed to all participants. The study protocol complied fully with the guidelines of the Ethics Committee of the Catholic University in Rome and was approved by the Institutional Review Boards in agreement with local requirements. It was conducted in accordance with Good Clinical Practice guidelines and the Declaration of Helsinki (1964) and subsequent revisions. Written informed consent was asked after a complete description of the study was provided to each subject. Participants were free to leave the study at any time. All subjects participated without receiving any form of payment.

2.3. Data analysis

2.3.1. Principal component analysis

Exploratory factor analysis was carried out through the principal component analysis method, run by SPSS for Windows, Versions 18.0 (SPSS Inc, Chicago, IL) in order to explore the dimensional structure of the "CTQ". More in detail, the principal component analysis was run with "direct oblimin rotation" to make the dimensional structure more understandable and to facilitate interpretation of the factors. In particular, direct oblimin rotation is the standard method for non-orthogonal solution, recommended when the factors are correlated [31].

As suggested in most relevant literature, the number of components extracted was based on the percentage of variance accounted for, the Kaiser-Guttman method and the scree plot [32]. Once we chose the number of components, we verified, through the communality matrix, if the factor model adequately represented each of the initial variables.

Each variable must have a score greater than or equal to .10, below which the variable is not properly reproduced in the factor solution. Subsequently, we verified the component loading of each variable. The higher the component loading, the greater the information that variable provides to that specific factor (see e.g. [33]). The component loading matrix is, therefore, necessary to distinguish items which consist of each latent factor.

2.3.2. Confirmatory factor analysis

Confirmatory factor analysis, carried out through structural equation modeling by use of LISREL 8.54 [34], allows

to verify the factor structure emerged from an exploratory model. Before verifying the model, it was necessary to create two parcels, that are item aggregations, for each latent variable to solve the problem of the model identification, reducing the number of items [35]. In order to verify the goodness of fit of the theoretical structural model with the observed data we calculated the Absolute Fit Indices (χ^2, RMR, SRMR and GFI) and Incremental Indices (NFI, NNFI, CFI).

2.3.3. Reliability

Finally, we calculated reliability, defined as the proportion of "true" variation in scores derived from a particular measure [28]. In particular, we decided to calculate Cronbach's alpha internal consistency reliability because the items were measured on a Likert scale. Cronbach's alpha can be written as a function of the number of test items and the average inter-correlation among the items [36]; it can assume values between 0 and 1.

George and Mallery [37] provide the following rules of thumb: "$\alpha > .9$ = Excellent, $\alpha > .8$ = Good, $\alpha > .7$ = Acceptable, $\alpha > .6$ = Questionable, $\alpha > .5$ = Poor, and $\alpha < .5$ = Unacceptable".

2.3.4. Threshold values

To determine threshold values we used the most commonly adopted calculation method in diagnostic test validation [32]. In particular, we calculated the mean value for each dimension and split up the normative sample into three levels. The first level indicates low scores on craving; this category includes subjects with a minor score of one standard deviation from the mean value. The second level includes subjects with medium scores, meaning scores of about one standard deviation from the mean value. Finally, the third level indicates subjects with high scores on craving; specifically, these are problematic individuals with a major score of one standard deviation from the mean value.

3. Results

3.1. Exploratory factor analysis in the normative sample

The factorial solution, obtained with the principal component analysis method, suggests a model with 3 components that accounts for 57.13% of the total variance. We chose to extract three factors based on the scree plot (Fig. 1), which shows that the eigenvalues are quite similar after the fourth factor. Also, only the first three factors have an eigenvalue greater than 1; overall, they account for a good percentage of the total variance.

Eigenvalues and the relative percentage of variance explained for each principal component are reported in Table 1.

Factors' description and interpretation were carried out based on the scores of saturation. The first component, referred to as "Relief Craving", encompasses items 18, 4, 3, 14 and 15, has an eigenvalue of 7.59 and accounts for 37.92% of the total variance. "Relief Craving" is associated with negative reinforcement, which is the termination of an aversive stimulus immediately following a performance (for example, item 14: "I usually drink when I am sad").

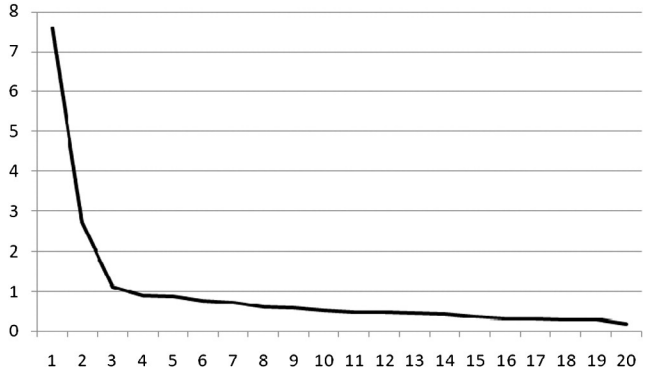

Fig. 1. Scree plot, showing the fraction of total variance in the data as explained or represented by each Principal Component.

The second dimension, "Obsessive Craving", measures the presence of obsessive thoughts concerning alcohol (for example, item 17: "Sometimes the idea of drinking is something that I cannot push out of my mind"). This dimension accounts for 13.64% of the total variance, has an eigenvalue of 2.73 and includes items 16, 20, 17, 12, 5, 6, 11 and 9.

The last dimension, "Reward Craving", encompasses items 13, 2, 19, 7, 8, 1, and 10, has an eigenvalue of 1.11 and accounts for 5.57% of the total variance. It is generally associated with positive reinforcement, which can be defined as the presentation of a reinforcing stimulus immediately following a performance (for example, item 1: "I crave to drink because I like it").

Table 1
Eigenvalue and percentage of variance explained.

	Eingivalue	% of Variance	% of Cumulative Variance
1	7.59	37.92	37.92
2	2.73	13.64	51.56
3	1.11	5.57	57.13
4	0.89	4.45	61.58
5	0.87	4.36	65.93
6	0.77	3.82	69.76
7	0.73	3.64	73.40
8	0.62	3.10	76.50
9	0.59	2.97	79.47
10	0.53	2.62	82.09
11	0.48	2.38	84.47
12	0.48	2.37	86.84
13	0.44	2.22	89.06
14	0.42	2.11	91.18
15	0.36	1.80	92.98
16	0.33	1.63	94.61
17	0.31	1.55	96.16
18	0.30	1.51	97.67
19	0.29	1.46	99.13
20	0.18	0.88	100.00

In order to verify the dimensional structure, we carried out the confirmatory factor analysis, realized through structural equation modeling. On the base of the results of principal component analysis, the final model (Fig. 2) consisted of 3 exogenous latent variables (represented in the ellipses) and 6 parcels of exogenous observed variables (two for each latent variable, represented in box).

Table 2 suggests a good fitting model. In particular, the results show that RMR and SRMS are largely inferior than .05, while the goodness of fit indices are higher than .97: the model is good [38] and it confirms the three-dimensional factorial structure.

In order to verify the internal consistency reliability, we calculated Cronbach's alpha coefficient for each dimension. Results are shown in Table 3.

Cronbach's alpha coefficients, varying from with .81 and .88, demonstrate that the CTQ has a good reliability.

After having verified CTQ's reliability, we calculated threshold values for each dimension (Table 4).

In order to verify CTQ's validity, we carried out a *t* test using the sample (normative or alcohol-dependent subjects) as an independent variable and CTQ's dimensions as dependent variables. T-value, degree of freedom, *p*-value and descriptive statistics are shown in Table 5; means and standard deviations are given for normative sample values and for alcohol-dependent subjects.

Table 2
Fit indices.

DF	X^2	SRMR	RMR	GFI	NFI	NNFI	CFI
6	32.73	.027	.011	.98	.98	.97	.99

We found that alcohol-dependent subjects had a significantly higher mean score as compared to the normative sample in "Relief Craving", "Obsessive Craving" and "Reward Craving". We can, therefore, assume that the CTQ is a valid questionnaire to distinguish a normative sample from pathological individuals.

Finally, younger age correlated with higher scores on Reward craving ($r = 0.38$; $p < 0.001$) and males ($M = 14.24$) reported significantly higher scores than women ($M = 12.12$) on Reward craving ($t = 4.36$; $p < 0.001$).

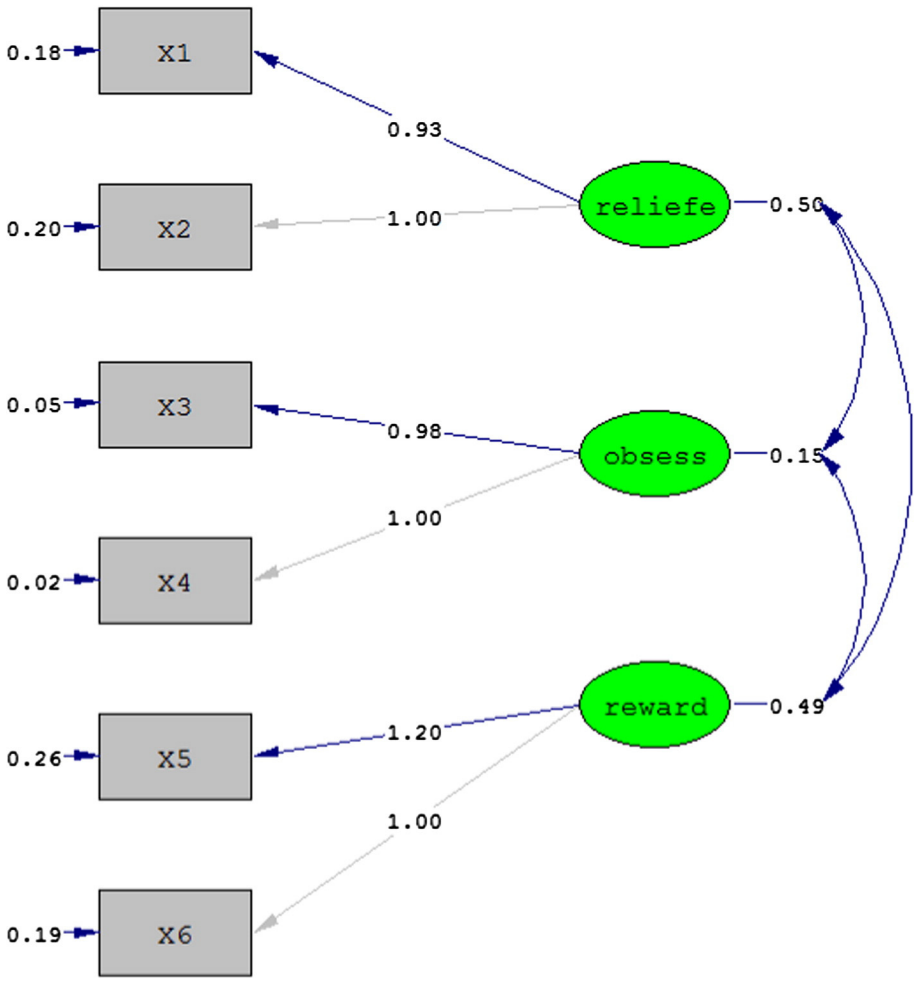

Fig. 2. Confirmatory factorial analysis: Structural Equation Modeling testing and estimating causal relations using a combination of statistical data and qualitative causal assumptions.

Table 3
Cronbach's alpha coefficient for each dimension.

Dimensions	Item	Cronbach's alpha coefficient
Relief Craving	5	.81
Obsessive Craving	8	.88
Reward Craving	7	.83

4. Discussion

The aim of the present study was to develop and validate a self-report questionnaire measuring three supposedly independent typologies of alcohol craving: relief, obsessive and reward craving.

The results of the exploratory factor analysis showed and confirmed that the CTQ is composed of three dimensions. We decided on the number of dimensions according to the criteria described in literature, i.e. eigenvalue greater than 1, percentage of variance accounted for and the scree-plot graph. Cronbach's alpha coefficients suggest that the questionnaire is reliable. Moreover, using threshold values, CTQ can be used for diagnostic purposes as it has proven to be valid in identifying pathological subjects.

The findings from the clinical sample of alcohol-dependent subjects confirm the correlation between reward craving, younger age and male gender. The average scores obtained represent the first normative data available for the Italian population. Larger numbers are certainly needed to confirm this instrument's validity and reliability in clinical samples.

Phenomena associated with craving may have important implications for alcoholism prevention and treatment. For example, high levels of craving are associated with increased probability of relapse, particularly during the early stages of the post-treatment period [39]. In addition, treatments that reduce craving have been shown to reduce subsequent alcohol use [40]. In the past decade there has been increasing interest in the use of medications (i.e., pharmacotherapy) to improve the effectiveness of psychosocial treatment approaches to alcoholism [41,42]. In fact, despite its psychological and social sequelae, once established, alcohol dependence is essentially a brain disorder, and craving itself has at its root a psychobiological mechanism that can be influenced by pharmacological agents. Alcoholism pharmacotherapy is based on the premise that alcohol use is mediated by specific neurobiological and behavioral mechanisms that initiate and maintain drinking. Several medications have been found to effectively reduce alcohol consumption in humans, and it has been reported that several of these drugs reduce alcohol craving as well. Researchers can reasonably conclude that medications which reduce craving may be effective in alcoholism treatment. However, not all patients benefit from the different treatment options available, as described in the prospective study COMBINE [43]. A promising strategy to improve the effectiveness of existing treatments is more efficient patient-treatment matching. Rating and differentiating the intensity of reward, relief, and obsessive craving could improve therapeutical choices in terms of pharmacological treatment options [44,45].

Table 4
Threshold values of Relief Craving, Obsessive Craving and Reward Craving.

Dimensions	Low	Medium	High
Relief Craving	$X \leq 4$	$4 < X < 12$	$X \geq 12$
Obsessive Craving	$X \leq 6$	$6 < X < 12$	$X \geq 12$
Reward Craving	$X \leq 8$	$8 < X < 18$	$X \geq 18$

Table 5
Student's t tests and descriptive statistics of normative sample and alcohol dependent subjects.

	t	df	*p*	Mean (SD)	Mean (SD)
				Normative Sample	Alcoholics
Relief Craving	−22.29	645	0.00	8.01 (3.71)	17.28 (4.40)
Obsessive Craving	−32.26	645	0.00	9.08 (3.15)	24.56 (8.49)
Reward Craving	−11.30	645	0.00	13.13 (5.77)	20.22 (5.77)

Craving type possibly represents an important predicting or matching variable for anti-craving compounds [45]. Verheul et al. [14] suggested that reward drinkers benefit from the anti-craving compound Naltrexone (an opiate antagonist), most likely through opioid receptor blockade. We think other drugs such as Nalmefene [46], Aripiprazole [47,48], Ondansetron [49], Topiramate [50,51] and Oxcarbazepine [52] may represent valid options for the treatment of reward craving. As to relief drinkers, Verheul et al. [14] proposed that Acamprosate (a glutamate antagonist), most likely via a reduction of neuronal hyperexcitability, may be effective. For relief drinkers, a role for Gabapentin [53], Pregabalin [54,55], Baclofen [56,57] and Acetyl-L-Carnetine [58] should be considered. With regard to obsessive craving, we believe that SSRIs [59,60], some mood stabilizers [51], topiramate and baclofen may represent valid options. However, at present these considerations are speculations and future trials are certainly necessary.

More research is needed with respect to CTQ's external validity, i.e. correlations with phenotypic, endophenotypic and genetic indicators of relief, reward and obsessive drinking, or a comparison with other (sub)scales, indicating convergent and divergent validity of each dimension. In addition, studies should be designed to determine the extent to which scores on the CTQ are sensitive to dynamic changes in alcohol use, and to the effects of other treatments. In the meantime, with this study, we propose a valid and reliable psychometric instrument able to differentiate craving into different typologies.

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