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Impaired control in heavy drinking and its association with alcohol craving and alcohol use disorder severity

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ABSTRACT

Introduction. Impaired control over drinking has been frequently cited in diverse theoretical descriptions regarding harmful alcohol use and is considered a DSM criterion for alcohol use disorder. Differences in the frequency of endorsement of impaired control have been viewed as a reflection of the severity of the problem. Moreover, it has been posited that the ability to place a limit on alcohol consumption may be mediated through enhanced craving. **Objective.** In this study, we addressed the relationship between impaired control, self-reported craving, and alcohol dependence severity among heavy drinkers. **Method.** We conducted a latent class analysis of impaired control dimensions (perceived control, failed control, and attempted control) of 208 heavy drinkers. To determine whether the identified classes could represent different forms of severity of the disorder, the best-fit model was contrasted with scores on the Alcohol Dependence Scale. Furthermore, we assessed the relationship between impaired control criteria (using the Impaired Control Scale [ICS]) with alcohol craving. **Results.** We identified a three-class solution based on impaired control severity. A graded increase of the craving scores and alcohol severity among the three classes was also identified. Only the ICS items comprising perceived control and partially those related to failed control, but not those evaluating attempted control, distinguished the gradient among the latent classes. **Discussion and conclusion.** This study provides further support of the proposal of a unidimensional continuum of severity among heavy drinkers and strengthens the theoretical relationship between impaired control and alcohol craving.

Keywords: Alcoholism, alcohol-related disorders, craving, executive function.

RESUMEN

Introducción. El deterioro del control sobre el consumo del alcohol se ha mencionado con frecuencia en diversas descripciones teóricas relativas al uso nocivo y es un criterio clínico del DSM para el trastorno por uso de alcohol. Las diferencias en la frecuencia con que se admite el deterioro del control se han considerado como un reflejo de la gravedad del problema. Además, se ha postulado que la capacidad de poner un límite al consumo de alcohol puede estar mediada por el deseo de consumirlo (*craving*). **Objetivo.** En este estudio se abordó la relación entre el deterioro del control, el autoreporte del *craving* y la gravedad de la dependencia del alcohol en un grupo de bebedores fuertes. **Método.** Se realizó un análisis de clases latentes usando las dimensiones del deterioro del control (control percibido, control fallido e intento de control) de 208 bebedores fuertes. Para determinar si las clases identificadas podían representar diferentes formas de gravedad del trastorno se contrastó el modelo más adecuado con las puntuaciones de la Escala de Dependencia del Alcohol. Además, se evaluó la relación entre los criterios de deterioro del control (utilizando la Escala de Control Deficiente, ECD) y el *craving*. **Resultados.** Identificamos una solución de tres clases basada en la gravedad del deterioro de control. En esa solución se identificó una relación con el aumento graduado de las puntuaciones de *craving* y la gravedad de la dependencia entre las clases. Sólo los elementos de la ECD que comprenden el control percibido y parcialmente los relacionados con el control fallido, pero no los que evalúan el intento de control, distinguieron el gradiente entre las clases latentes. **Discusión y conclusión.** Este estudio proporciona más apoyo a la propuesta de un continuum unidimensional de gravedad entre los usuarios de alcohol y refuerza la relación teórica entre el fenómeno de deterioro del control y el *craving*.

Palabras clave: Alcoholismo, trastornos relacionados con el alcohol, *craving*, funciones ejecutivas.

INTRODUCTION

A significant advance in the understanding of the problems associated with heavy drinking has been the transition from the notion of alcoholism as a monolithic clinical entity to the concept of an alcohol dependence syndrome as a dimensional construct, as was proposed decades ago by Edwards and Gross (1976). The validity and strength of this proposal that emphasizes quantitative differences along a continuum of diverse behavioral expressions and subjective cognitive responses related to alcohol consumption have pervaded the current definitions of the problems associated with use of the substance (e.g., alcohol use disorders in DSM-5) (Hasin et al., 2013). Within this conceptual framework, the theoretical construct of impaired control over drinking is particularly relevant (Heather, Tebbutt, Mattick, & Zamir, 1993). Impaired control over drinking has been defined as “the breakdown of an intention to limit consumption in a particular situation” or “a pattern of alcohol use that supersedes conscious intentions to limit use on specific occasions” (Heather et al., 1993; cited in Leeman et al., 2014); these definitions encompass those events in which an individual’s intentions to abstain or to stop drinking once started have been futile.

Two behavioral/cognitive facets of impaired control are intrinsic to this definition: the use of a specific substance in more substantial amounts or for a more extended period than intended (“larger/longer;” LL) and the persistent desire or unsuccessful attempts to cut down or control its use (“quit/control;” QC) (Hasin & Beseler, 2009; Kahler, Epstein, & McCrady, 1995). Their clinical significance has been long recognized both in the International Classification of Diseases (ICD) as well as in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM). Currently, they remain in the DSM-5 clinical criteria for diagnosing an alcohol use disorder (AUD).

Considering the importance of maintaining control over drinking and recognizing that the affected/unaffected dichotomous classification fails to capture the heterogeneity of the disorder, in this study, we aimed to establish whether the (dis)ability to place a limit on alcohol consumption would discriminate in a dimensional arrangement a group of heavy drinkers who sought therapeutic support at a specialized clinic. To this end, employing a latent class analysis (LCA), we determined the best-fit categorical discrimination model to the responses given to the Q/C and L/L DSM-IV-TR diagnostic criteria. Subsequently, we compared the participants scores on the Alcohol Dependence Scale (ADS) to determine whether these classes could reliably represent different forms of severity of the disorder. Furthermore, as a measure of criterion validity, we contrasted the scores reported on the Impaired Control Scale (ICS) which is an instrument developed for measuring some facets of impairment over control of alcohol consumption. Finally, since it has been posited that the ability to place a limit on alcohol

consumption may be mediated through enhanced craving, we examined the Obsessive-Compulsive Drinking Scale (OCDS) scores between classes.

METHOD

Participants

Participants were 208 adult males and females voluntarily seeking treatment at the Center for Assistance for Alcoholics and their Families (CAAF; <http://inprf.gob.mx/clinicos/caafi.html>), a satellite clinic of the Instituto Nacional de Psiquiatría Ramón de la Fuente Muñiz (INPRFM) in downtown Mexico City. CAAF is a facility dedicated solely to patients whose primary substance use problem is alcohol. Admission to clinical services required that individuals were not intoxicated. All participants were inhabitants of the Mexico City metropolitan area.

As part of the admission routine, clients filled out a form with sociodemographic data along with a checklist of endorsement of the DSM-IV-TR clinical criteria for alcohol abuse and alcohol dependence (American Psychiatric Association, 2000). This report is a secondary data analysis of patient records.

Measurements

The Alcohol Dependence Scale (ADS) (Skinner & Allen, 1982; Skinner & Horn, 1984) is a self-report measure to evaluate alcohol consumption-related impairment symptoms manifested in areas of physical, intellectual, social, and psychiatric functioning. The score generated from the sum of 25 items provides, therefore, a continuous measure of the severity of the syndrome (i.e., low, moderate, substantial, and severe) consistent with the concept of alcohol dependence as a continuum. Data on the factorial structure, internal consistency, sensitivity, specificity, and predictive values of the Spanish version of the ADS used here, have been previously reported (Solís, Cordero, Cordero, & Martínez, 2007).

The Impaired Control Scale (Heather et al., 1993; Heather, Booth, & Luce, 1998) measures, as a continuous variable, cognitive, and behavioral features often displayed during episodes of impaired control in the last six months. The 25 items are integrated into three dimensions: The first one estimates the frequency of attempts to exercise control over drinking (Attempted control), the second one evaluates the frequency of difficulties or failures to control his/her drinking (Failed control), and the third assesses the individual’s perception of his/her anticipated ability to control or resist drinking if it were attempted (Perceived control). Marsh, Smith, Saunders, and Piek (2002) documented the factor structure, internal consistency, and validity of the scale.

Finally, the Obsessive–Compulsive Drinking Scale (Anton, 2000), a 14-item questionnaire adapted from the Yale-Brown Obsessive-Compulsive Drinking Scale, was developed on the theoretical notion of similarity between obsessive-compulsive phenomenology and alcohol craving (Modell, Glaser, Cyr, & Mountz, 1992; Modell, Glaser, Mountz, Schmaltz, & Cyr, 1992), and has been considered among the better performing multi-item measures for craving assessment (Kavanagh et al., 2013; Drobles & Thomas, 1999). Clinical, neurobiological, and neuropsychological research provide support for this proposal. For the present analysis, the scores from five specific items of the OCDS were used as measures of two dimensions relevant to craving (i.e., intensity and duration of thoughts/feelings and behavioral intentions) (de Wildt et al., 2005; Cordero, Solis, Cordero, Torruco, & Cruz-Fuentes, 2009).

Latent Class analysis (LCA)

A LCA was conducted using three questions included in the alcohol dependence criteria's checklist that each patient had to fill out upon admission to the CAAF. The endorsement of these questions had the intention to assess the “larger/longer” (LL) and “quit/control” (QC) facets of impaired control over drinking (i.e., to use the substance more or for a more extended period than intended and to have a persistent desire or unsuccessful attempts to cut down or control its use). As reviewed by Leeman et al. (2014), several cross-sectional and longitudinal studies support the pertinence of LL and QC criteria in the definition of impaired control.

The following measures of good-fitness were assessed: adjusted-Bayesian Information Criteria (aBIC), Akaike Information Criterion (AIC), Bayesian Information Criteria (BIC), Bootstrapped Likelihood Ratio Test (BLRT), Lo-Mendell-Rubin test (LMR), entropy, and the Vuong-Lo-Mendell-Rubin test (VLMR). As suggested by Nylund, Asparouhov, and Muthén (2007), to determine the model with the best-fit, the following criteria were applied: the one with the lowest BIC and aBIC value, the highest entropy value and the significance value of BLRT with a $p < .05$. The Latent Class Analysis was performed with the M-plus 8.1 statistical package.

A three-step procedure was performed to assess the difference between classes in distal outcomes (Vermunt & Magidson, 2002; 2005). In this procedure, comparisons of categorical or numerical variables were carried out, correcting the classification error. The value of statistical significance was set to $p < .05$.

Ethical considerations

During their admission to the CAAF, clients gave their informed consent so that the collected clinical data could be used later for research purposes. The Ethics and Research

Committees of the INPRFM approved this secondary analysis of data.

RESULTS

Demographic characteristics and family history of alcohol use disorder

Included in this analysis were 208 adults (40 ± 8 years old), mostly male (86% of the sample), and living with a stable partner (63%). Approximately two-thirds attained middle- or high-school education, and 78% reported a remunerated occupation (however, most frequently low-paid and informal). Regarding family history, 65% of the participants reported at least one family member with alcohol-related problems, commonly the biological father. The mean ADS (\pm SD) score was 23.7 ± 11.4 , indicating that, although as a group they shared the heavy drinking trait, they also expressed a broad spectrum of severity of their drinking problems at admission.

Selection of the latent class model

The LCA identified 2-, 3-, and 4- class solutions with generally good-fit profiles (Table 1A). The 2-class model was dismissed as it showed the highest AIC, BIC, and aBIC scores. On the other hand, the 4-class model showed a slight fit improvement as compared to the 3-class model (i.e., similar BIC and BLRT significance values, but lower values of aBIC and entropy). Nonetheless, the latter solution was selected according to its ability to discriminate in a more

Table 1

	Number of classes		
	2	3	4
A. Adjustment profiles for Latent Class Analysis			
AIC	3028.7	2959.8	2930.2
BIC	3095.4	3056.6	3057
aBIC	3032.1	2964.7	2936.6
Entropy	.819	.815	.846
VLMR*	.000	.036	.056
LMR*	.000	.038	.059
BLRT*	.000	.000	.000
B. Probability of belonging to a latent class			
Class	1	2	3
1	.92	.07	0
2	.05	.89	.04
3	0	.05	.94

Classification quality: Entropy .815

Notes: aBIC = adjusted-Bayesian information criteria; AIC = Akaike information criterion; BIC = Bayesian information criteria; BLRT = bootstrapped likelihood ratio test; LMR = Lo-Mendell-Rubin test; VLMR = Vuong-Lo-Mendell-Rubin test. * p -values.

Table 2
Comparison of sociodemographic data between latent classes

	Class 1	Class 2	Class 3
Number individuals per class (% from the total sample)	47 (22)	97 (46)	64 (30)
Age (years)	41.9	40.7	40.8
% men	85	85	89
% unemployed	10.6	20.6	32.8
% living with an enduring companion	82.8	69.1	61.7
% with a family history of alcohol use problems	51.1	66	75

continuous pattern, the variables of drinking control, craving, severity of consumption, and perception of control (Table 1B).

Comparison between classes

As seen in Table 2, the three classes identified were similar for age and sex. On the contrary, there were substantial differences in the frequency of having a paid job, living with a stable partner, and a family history of alcohol use disorders. Regarding severity reported on the ADS, a graded pattern of severity was identified and individuals from Class 1 obtained a mean score \pm standard deviation of 15.3 ± 9 ; those from Class 2 a mean \pm standard deviation of 23 ± 8.8 ; and Class 3 a mean \pm standard deviation of 31.8 ± 10.4 ($\chi^2_{1-2,3} = 87.6$, $p < .01$).

Table 3 shows the mean scores (SD) for the dimensions of impaired control derived from the ICS sub-scales between latent classes. In comparison with subjects included in the first class, unsuccessful attempts to cut down or control alcohol consumption and beliefs regarding the inability to control drinking were noticeable stronger for the individuals in classes 2 and 3. Between-class differences were not identified, however, for deliberate efforts to limit the time/amount dedicated to drinking.

Finally, a clear-cut sequential increase of craving scores (measured by the OCDS) between classes was distinguished (Table 4). This outcome applied equally to the total score and the factors of thoughts/feelings (obsessions) and behavioral intentions.

Table 3
Impaired control scale by Latent classes

Dimension assessed	Content	Class 1	Class 2	Class 3	Kruskal-Wallis test
Attempted control	attempts to exercise control over drinking	8.3 (5.2)	9.2 (4.9)	9.4 (5.8)	Chi square = .99, gl 2; $p = \text{n.s.}$
Failed control	difficulty or failure to control drinking	12.7 (7.9)	18.1 (6.5)	21.7 (6.6)	Chi square = 38.9, gl 2; $p < .01$
Perceived control	perception of anticipated ability to control or resist drinking if it were attempted	23.9 (9.3)	28.8 (6.2)	30.2 (8.6)	Chi square = 18.9, gl 2; $p < .01$

Notes: Data represent mean scores (SD). N.S. Non-significant differences at $p < .05$

DISCUSSION AND CONCLUSION

In this study, we used the person-centered approach of latent class analysis to establish whether impaired control over drinking would discriminate in a dimensional arrangement a group of heavy drinkers who sought therapeutic support at a specialized outpatient alcohol treatment clinic in Mexico City. We found that a 3-class solution characterized a progressive pattern of severity level (i.e., moderate, mild, and substantial), supporting the view that alcohol use disorders reflect a unidimensional continuum. Non-surprisingly, this graded system was associated with social and personal deterioration as shown by increased unemployment and higher absence of a stable partner. Interestingly, this model also correlated with a higher prevalence of a family history of alcohol use problems.

Our findings are consistent with previous LCA studies that examined the likelihood of endorsement of various DSM-IV/DSM-5 alcohol use symptoms. In these reports, 3- or 4-class solutions were favored, suggesting a comparable spectrum of severity in affected adults (DSM-IV: Bucholz et al., 1996; Foroud et al., 1998; Chung & Martin, 2001; Muthén, 2006; DSM5: Castaldelli-Maia et al., 2014). Moreover, the high correlation reported by others for measurements of impaired control and alcohol dependence (Chick, 1980; Heather et al., 1993; Marsh & Saunders, 2000) supports their close relationship.

We also found that only the impaired control dimensions of perceived control and partially those related to failed control, but not those evaluating attempted control, distinguished a gradient between the latent classes. A possible interpretation of this partial correspondence could be related to the theoretical content of each dimension. The attempted control subscale was designed to rule out the possibility that some drinkers had little or null intention to control their alcohol consumption; thus, this subscale may not be related per se to the impaired control construct. Therefore, from these results, one can infer that all individuals evaluated in this work were similar in: "...the extent to which (they) had formed a conscious intent to exert control over drinking in the previous months" (cited in Heather et al., 1993, page 707).

On the other hand, perceived control and failed control correlate strongly (see Heather et al., 1993; 1998; Marsh &

Table 4
Craving scores in latent classes

<i>Obsessive Compulsive Drinking Scale Factors</i>	<i>Class 1</i>	<i>Class 2</i>	<i>Class 3</i>	<i>F Statistic</i>
Thoughts	.9 (1.1)	3.0 (1.6)	5.7 (1.9)	119.5*
Feelings	.4 (0.5)	1.5 (.8)	3.0 (.7)	208.2*
Behavioral intentions	.7 (0.6)	3.2 (1.2)	6.1 (1.4)	312.5*
Total score	1.9 (1.7)	7.7 (2.3)	14.7 (2.4)	465.3*

Notes: * $g/1 = 2$; p -value < .001

Saunders, 2000). Therefore, the increased score trend detected in both subscales, particularly evident between individuals from class 1 in comparison to those from classes 2 and 3, could represent different stages of progression of the deterioration of beliefs about the foreseen ability to control alcohol use and their failed experiences. Moreover, it has been described that both the scores for failed control and those for perceived control show a moderate but positive correlation with measures of alcohol dependence (Heather et al., 1993; 1998), strengthening the theoretical link between impaired control and severity of the AUD.

We also identified a graded increase in the craving scores among the classes identified. This was equally true for the total score and for the two factors of the craving model evaluated (i.e., thoughts/feelings and behavioral intentions) (de Wildt et al., 2005). In an independent cohort, we previously reported that craving correlated with symptom severity (as measured by the ADS), the number of DSM-IV criteria met and the numbers of days per week engaged in alcohol consumption (Cordero et al., 2009), strengthening the link between intensity of craving and severity of the disorder.

Diverse authors have posited a fundamental theoretical role of craving in influencing alcohol drinking behavior (and other substances also) (e.g., Sayette, 2016). Furthermore, its clinical relevance is reflected as a criterion in the definition of ICD's dependence syndrome due to alcohol use (F1x.2) and its most recent inclusion for the diagnosis of AUD in the DSM-5. Specifically, it has been stressed that craving might adversely affect one's ability to refrain from drinking, despite intentions to cut down or abstain (Kranzler, Mulgrew, Modesto-Lowe, & Burleson, 1999), in such a way that it has been recurrently invoked as a risk factor for relapsing, and consequently considered as a putative target for clinical treatment.

Alternatively, impaired control might moderate the link between craving and consumption. The relationship between impaired control symptoms and alcohol craving as a potentially harmful factor for dysregulated drinking have been described in some studies. For example, Modell, Mountz, Glaser, and Lee (1993) reported that both individuals with alcohol abuse and those with dependence manifested an increased subjectively rated craving response and

perception of being unable to resist additional alcohol consumption, following an initial alcohol dose.

Interestingly, in a national U.S. survey of drinking patterns (Caetano, 1999), impaired control was a more frequently reported reason for not being able to quit or cut down than as the motive for continuing to drink after promising oneself not to. Furthermore, Wardell, Ramchandani, and Hendershot (2015), employing a controlled alcohol self-infusion paradigm, found that fluctuations in the intensity of subjective (stimulation or sedation) individual responses over time were associated with equivalent changes in the motivation to get more of the alcohol infusion (i.e., craving). This state variable predicted, in turn, level of consumption (as measured by breath alcohol). Of utmost importance was the observation that this association between the subjective responses and alcohol intake (mediated via craving) was conditional to the impaired control expressed. Notably, they recently described that those reporting relatively greater impaired control (operationalized as a function of altered behavioral response to an ingenious alcohol challenge), awarded higher scores to a specific item assessing craving, as compared to those with less impaired control. Moreover, craving mediated the relationship between their self-report and the discrepancies identified between the initially intended vs. the actual alcohol concentration infused, an indirect index of the subjective intention to limit consumption (Wardell, Le Foll, & Hendershot, 2018). Overall this suggests that impaired control might partially reflect an inability to control alcohol consumption in response to a strong desire or urge to drink.

When interpreting the findings of the present study, some methodological limitations should be noted. For example, while latent class analysis (as was applied here) supports the arrangement of heavy drinkers along a continuum, it may not consider the within-individual differences in severity (Saha, Chou, & Grant, 2006). Application of alternative statistical approaches such as the item response theory to examine if the diversity of alcohol use behaviors correlates to a broad and continuous dimension of severity is warranted in future studies. Moreover, our sample consisted of outpatient clients who voluntarily sought help at a dedicated treatment center for alcohol use problems, with an alcohol dependence severity (as assessed by the ADS) in the range of moderate to substantial. Therefore, statistical correspondence between the scales used and classes identified could have been attenuated, to some extent, due to the restricted range of observed scores. Examination of individuals expressing higher severity levels (e.g., inpatients population) or in other stages of drinking problems development (e.g., young binge drinkers) might give additional support to the hypothesis of a severity continuum. Lastly, while the self-rated OCDS provides a general measure of what seems to be an essential behavioral/cognitive dimension with heuristic value, it might not fully capture the broad concept of

craving, limiting the interpretation of its relationship with impaired control.

This study contributes to the understanding of heavy alcohol drinking by providing further evidence of a continuum of severity underlying an interplay of impaired control and craving. As Litten et al. (2015) wrote, this dimensional pattern could be assumed as: "... some form of sub-phenotypes, each having its unique profile of drinking pattern, the motivation for drinking, alcohol-related consequences, and neurobiological underpinnings."

Undoubtedly, there is high heterogeneity in the behavioral expressions associated with alcohol use, which can range from occasional and limited consumption to excessive and relapsing intoxication. To improve our understanding of the multiple factors involved, we need empirical testing of innovative theoretical frameworks. One such novel framework, the Research Domain Criteria (RDoC) matrix of domains and constructs (Insel et al., 2010; Cuthbert & Insel, 2013) could be applied to alcohol research (Litten et al., 2015; Kwako, Momenan, Litten, Koob, & Goldman, 2016). The RDoC approach has been evoked recently to study the subjective response to alcohol (Ray, Bujarski, & Roche, 2016) and to evaluate the dimensional capacity of exerting control over alcohol consumption (Sánchez & Cruz-Fuentes, 2016).

In summary, our study provides additional insight into the interwoven relationship between impaired control, craving, and alcohol dependence severity among heavy drinkers. Certainly, future studies are warranted.

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Conflicts of interest

The authors declare they have no conflicts of interest.

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