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The Value of Impulsivity to Define Subgroups of Addicted Individuals Differing in Personality Dysfunction, Craving, Psychosocial Adjustment, and Wellbeing: A Latent Class Analysis

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Abstract

High impulsivity is common to substance and gambling addictions. Despite these commonalities, there is still substantial heterogeneity on impulsivity levels within these diagnostic groups, and variations in impulsive levels predict higher severity of symptoms and poorer outcomes. We addressed the question of whether impulsivity scores can yield empirically driven subgroups of addicted individuals that will exhibit different clinical presentations and outcomes. We applied latent class analysis (LCA) to trait (UPPS-P impulsive behavior scale) and cognitive impulsivity (Stroop and d2 tests) scores in three predominantly male addiction diagnostic groups: Cocaine with Personality Disorders, Cocaine Non-comorbid, and Gambling and analyzed the usefulness of the resulting subgroups to differentiate personality beliefs and relevant outcomes: Craving, psychosocial adjustment, and quality of life. In accordance with impulsivity scores, the three addiction diagnostic groups are best represented as two separate classes: Class 1 characterized by greater trait impulsivity and poorer cognitive impulsivity performance and Class 2 characterized by lower trait impulsivity and better cognitive impulsivity performance. The two empirically derived classes showed significant differences on personality features and outcome variables (Class 1 exhibited greater personality dysfunction and worse clinical outcomes), whereas conventional diagnostic groups showed non-significant differences on most of these measures. Trait and cognitive impulsivity scores differentiate subgroups of addicted individuals with more versus less severe personality features and clinical outcomes.

Keywords: Addiction; Personality and Personality Disorders; Psychosocial Functioning; Quality of life; Statistical Methods

Introduction

The term impulsivity refers to behavior that is performed with little or inadequate forethought such that it results in undesirable consequences for self or others (Evenden, 1999; Moeller, Barrat, Dougherty, Schmitz, & Swann, 2001). Accordingly, impulsivity has been trans-diagnostically associated with a number of debilitating psychiatric disorders including substance use, gambling, and personality disorders (Robbins, Gillan, Smith, de Wit, & Ersche, 2012; Steel & Blaszczynski, 1998). This notion has been recently incorporated into the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (American Psychiatric Association, 2013), which merges substance use and gambling disorders under the addiction diagnostic category based—among others—on their common impulsive features (Petry, 2001). These commonalities include similarly increased trait impulsive levels and similarly decreased performance on cognitive measures of selective attention and response inhibition (Albein-Urios, Martinez-González, Lozano, Clark, & Verdejo-García, 2012; Goudriaan, Oosterlaan, de Beurs, & van den

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Brink, 2006; Lawrence, Luty, Bogdan, Sahakian, & Clark, 2009) which have shown sound correspondence with trait impulsivity levels (Cyders & Conskunpinar, 2011; Perales, Verdejo-García, Moya, Lozano, & Pérez-García, 2009).

Despite these commonalities, there is still substantial heterogeneity on impulsivity levels within these diagnostic groups (Verdejo-García, Lawrence, & Clark, 2008). This heterogeneity entails significant clinical implications, since higher levels of impulsivity are significantly associated with more severe clinical symptoms and poorer psychosocial outcomes in cocaine use (especially when co-existing with comorbid personality disorders) and gambling disorders (Bornovalova, Levy, Gratz, & Lejuez, 2010; Ledgerwood & Petry, 2010). More specifically, the emotion-driven dispositions to impulsive behavior (e.g., negative urgency) and the attention/response inhibition aspects of cognitive impulsivity have been uniquely associated with increased severity of symptoms and poorer outcomes in both cocaine (Bornovalova, Levy, Gratz, & Lejuez, 2010; Verdejo-García, Bechara, Recknor, & Pérez-García, 2007) and gambling addictions (Brevers et al., 2012; Torres et al., 2013).

In view of substantial heterogeneity on impulsivity levels within addiction diagnostic groups, and relevance of this heterogeneity to describe higher severity and poorer outcomes, we addressed the question of whether impulsivity scores can yield empirically driven trans-diagnostic subgroups of addicted individuals that will exhibit different clinical presentations and outcomes. These subgroups may contribute to provide better proxies of addiction severity and outcomes compared with traditional diagnostic labels. To test these assumptions, we applied latent class analysis (LCA) to trait and cognitive impulsivity scores in three addiction diagnostic groups (cocaine with personality disorders, cocaine non-comorbid, and gambling) and analyzed the usefulness of the resulting subgroups to differentiate personality beliefs and relevant outcomes: Craving, psychosocial adjustment, and quality of life (Tiffany, Friedman, Greenfield, Hasin, & Jackson, 2012). The LCA approach is ideally suited to uncover unobserved heterogeneity within diagnostic groups with similar impulsive profiles and well characterized to discard state-dependent confounders (e.g., acute or subacute drug effects, Axis I comorbidities). We predicted that the LCA-driven impulsivity subgroups will unveil significant differences on personality dysfunction and outcome measures beyond those detected by conventional diagnostic groups.

Methods

Participants

Ninety-six European-Caucasian individuals with cocaine use and gambling disorders diagnoses participated in this study as part of a larger research on cocaine and personality disorders (COPERNICO project). Thirty-eight individuals were diagnosed with cocaine use and personality disorders from Cluster B and Cluster C, 32 individuals were diagnosed with cocaine use disorders without other current Axis I or Axis II comorbidities, and 26 individuals were diagnosed with gambling disorders without other current Axis I or Axis II comorbidities. The three diagnostic groups were statistically matched for age, education, and IQ distributions and for tobacco, alcohol, and cannabis amount and durations of use.

Cocaine users were recruited as they started treatment in the clinic "Centro Provincial de Drogodependencias (CPD)" in Granada (Spain), which provides behavioral treatment for substance-related disorders in an outpatient setting. Gambling users were recruited as they started treatment in the clinic "Asociación Granadina de Jugadores en Rehabilitación (AGRAJER)" also located in Granada (Spain). This outpatient facility gives self-help oriented interventions for problem gambling and is the main public funded treatment service for gambling problems in the south of Spain.

The inclusion criteria for the cocaine and gambling groups were defined as follows: (a) age range between 18 and 50 years old; (b) IQ levels above 80—as measured by the Kaufman Brief Intelligence Test (K-BIT; Kaufman & Kaufman, 1990); (c) meeting DSM-IV criteria for cocaine dependence (for the cocaine groups) or pathological gambling (for the gambling group)—as assessed by the Structured Clinical Interview for DSM-IV Disorders-Clinician Version (SCID; First, Spitzer, Gibbon, & Williams, 1997); (d) being treatment commencers; and (e) abstinence duration >15 days—as determined by twice weekly urine tests in cocaine users and self- and informant reports in pathological gamblers. Inclusion criteria for cocaine-dependent patients with comorbid personality disorders were restricted to diagnoses pertaining to Cluster B ($n = 34$) and Cluster C ($n = 17$), which are the more prevalent among cocaine users (Chen et al., 2011). Axis II disorders were assessed using the International Personality Disorders Examination (Loranger et al., 1994; Spanish version by López-Ibor, 1999). Cluster B diagnoses included antisocial ($n = 6$), borderline ($n = 16$), narcissistic ($n = 1$), and histrionic ($n = 11$). Cluster C diagnoses included avoidant ($n = 11$) and obsessive-compulsive ($n = 6$).

The exclusion criteria were: (a) presence of any other current Axis I disorders—with the exceptions of alcohol abuse, nicotine dependence, and attention deficit and hyperactivity disorder (ADHD)—as measured by the Conners' Adult ADHD Diagnostic Interview for DSM-IV (CAADID; Conners, 1999); (b) history of head injury or neurological, infectious, systemic, or any other diseases affecting the central nervous system; (c) having participated in other behavioral treatments within the 2 years preceding the study onset; and (d) having entered treatment by court request. Comorbid Axis I disorders were assessed with the SCID.

All the diagnoses were conducted by a board certified clinical psychologist, whereas all subsequent tests were administered by an independent (blind to diagnosis) assessor.

Measures

Classification measures: Trait and Cognitive Impulsivity. Trait Impulsivity was measured with the UPPS-P impulsive behavior scale (Whiteside & Lynam, 2001). Specifically, we used the Spanish version of the scale, which has shown sound reliability and internal and construct validity (Verdejo-García, Lozano, Moya, Alcázar, & Pérez-García, 2010). The scale contains 59 items designed to comprehensively assess different personality pathways leading to impulsive behavior: Sensation seeking, lack of perseverance, lack of premeditation, negative urgency, and positive urgency. Sensation seeking (12 items) incorporates two aspects: (a) the tendency to enjoy and pursue activities that are exciting, and (b) an openness to trying new experiences that may or may not be dangerous; lack of perseverance (10 items) refers to an individual's ability to remain focused on a task that may be boring or difficult; lack of premeditation (11 items) refers to the tendency to think and reflect on the consequences of an act before engaging in that act; and finally urgency (26 items) refers to the tendency to experience strong impulses under conditions of negative affect (negative urgency, 12 items) or positive affect (positive urgency, 14 items). The reliability of the different subscales (Cronbach's α) ranged from 0.75 (lack of perseverance) to 0.93 (positive urgency). We obtained the total scores of each of these UPPS-P dimensions for analyses.

Cognitive impulsivity was measured with two neuropsychological tests of selective attention and response inhibition which have empirically demonstrated validity to represent the construct of impulsivity (Cyders & Coskunpinar, 2011; Perales, Verdejo-García, Moya, Lozano, & Pérez-García, 2009).

Stroop Color-Word Interference Test (CWIT; Delis, Kaplan, & Kramer, 2001). This version of the Stroop includes a series of four conditions. The first condition (C1) presents patches of colors and participants have to name them as quickly and accurately as they can. The second condition (C2) presents the words "red," "blue," and "green" printed in black ink and participants are asked to read aloud the words written. The third condition (C3) introduces the inhibition demand: The words "red," "blue," and "green" are printed in incongruent colors ink and participants have to name the color and ignore the word. In the fourth condition (C4), the items are similar to condition 3 but participants have to switch their response between naming the color of the ink and ignoring the word or reading the word (when the item is framed). Based on our study aims, we used as our performance index the response inhibition score, resulting from the formula Time on C3 minus Time on C1.

d2 Cancellation Test (Brickenkamp, 2002). This test includes 14 different lines of letters including targets (d's with two dashes) and distracters (e.g., d's with less than two dashes, p's, etc.). Participants are asked to cancel each of the targets while ignoring the distracters. Based on our study aims, we used as our performance index the efficiency score: Total number of trials minus total number of errors, indexing selective attention and inhibition of distracters.

Dimensional measures of addictive behavior and personality dysfunction. Substance use behavior: Interview for Research on Addictive Behavior (Verdejo-García, López-Torrecillas, Aguilar de Arcos, & Pérez-García, 2005). This interview collects self-reported information about patterns of drug use including the age at onset of the substances used, monthly use of each substance during regular use and last month (amount per month), and the total duration of use for each substance (duration in months).

Dysfunctional beliefs: Personality Belief Questionnaire (PBQ; Beck & Beck, 1991). The PBQ is a self-report questionnaire that consists of 10 subscales that measure specific beliefs and assumptions associated with the different personality disorders. Here, we used the nine scales corresponding to different clusters of personality disorders: Paranoid and schizoid (Cluster A), antisocial, borderline, histrionic, and narcissistic (Cluster B), and avoidant, dependent, and obsessive-compulsive (Cluster C). The Spanish version of the questionnaire holds appropriate psychometric characteristics (Albein-Urios, Martínez-González, Lozano, & Verdejo-García, 2011) and the reliability coefficients of the different scales in this sample ranged from Cronbach's = 0.71 (narcissistic) to Cronbach's = 0.88 (borderline).

Outcome measures. Craving was measured with the Weiss Craving Questionnaire (Weiss et al., 1997). This questionnaire is composed of five items that measure different aspects of craving during addiction treatment. We computed the total craving scores for our analyses.

Psychosocial adjustment was measured with the General Health Questionnaire (GHQ-28; Lobo, Pérez-Echevarria, & Artal, 1986). This questionnaire is composed of 28 items corresponding to four dimensions of psychological and social adjustment in the context of psychiatric disorders: somatic complaints, anxiety, social dysfunction, and depression.

Quality of life was measured with the Health-Related Quality of Life for Drug Users (Lozano, Rojas, & Pérez, 2009; Zubaran et al., 2012). This 20-item self-report inventory has demonstrated validity to assess subjective quality of life in individuals with

substance use disorders. It provides a total score representing global subjective well-being. Due to its specific validity in substance using populations, we did not apply this measure to the gambling group.

Statistical Analysis

We initially conducted one-way analyses of variance to examine differences between diagnostic groups (Cocaine + Personality Disorders, Cocaine, Gambling) on impulsivity, substance use, personality beliefs, and outcome measures. Next, we applied LCA to impulsivity scores in all participants in order to obtain novel subgroups of individuals differing on impulsivity profiles. LCA assumes that the covariation between manifest indicators arises by virtue of their association with underlying classes. LCA facilitates the extraction of distinct and meaningful subgroups based on the unobserved heterogeneity within a population and on the similarity between their response profiles (Reboussin, Young Song, Shrestha, Lohman, & Wolfson, 2006). Here, we employed the trait and cognitive impulsivity indices as indicators for the LCA. Specifically, we used the UPPS-P scales scores (sensation seeking, lack of perseverance, lack of premeditation, negative urgency, and positive urgency), the Stroop Inhibition score, and the d2 Efficiency score. The selection of the number of latent classes that best described our data was conducted using the Bayesian information criterion (BIC) and the Akaike information criteria (AIC). The BIC and AIC are descriptive fit indices wherein smaller values indicate better model fit. In addition, each model was assessed on its interpretability to determine if the classes actually represented different categories (Muthén, 2006). The LCA model yields two types of estimated parameters: (a) class membership probabilities, reflecting the relative size or prevalence of each class and (b) class-specific endorsement probabilities, reflecting the likelihood of endorsement of a given indicator for individuals in a particular class (Uebersax, 1994). We used Latent Gold 4.0 software for model-fitting. The latent class membership was saved for use in subsequent bivariate analyses conducted in SPSS v. 17.

To address the main prediction of the study, we next performed independent-sample *t*-tests or χ^2 tests to analyze the association between LCA-derived membership and diagnostic composition (presence of comorbid personality disorders), personality beliefs, and outcome measures (craving, psychological adjustment, and subjective quality of life). The LCA model was applied to the whole sample ($n = 92$) but, because questionnaire data were missing, the sample size for clinical and outcome measures was $n = 69$ for PBQ scores and $n = 76$ for psychosocial and outcome measures.

Results

Differences Between Diagnostic Groups on Clinical and Outcome Measures

Results are presented in Table 1. The three diagnostic groups (cocaine with personality disorders, cocaine, and gambling) showed statistically significant differences in the UPPS-P negative urgency subscale, $F(2, 90) = 9.69$, $p < .05$; and in the PBQ Schizoid, $F(2, 67) = 3.73$, $p < .05$, Borderline, $F(2, 67) = 3.73$, $p < .05$, and Narcissistic, $F(2,67) = 4.09$, $p < .05$, subscales. In all cases, cocaine users with personality disorders had higher scores than cocaine non-comorbid users and gamblers. Diagnostic groups showed non-significant differences in the cognitive measures of impulsivity (Stroop and d2), the four remaining UPPS-P subscales or the six remaining PBQ subscales. As for outcome measures, diagnostic groups showed non-significant differences in craving or psychosocial outcome, although cocaine users with personality disorders showed poorer perceived quality of life than cocaine non-comorbid users.

Extraction of Impulsivity-Based Groups: LCA Results

We explored five different solutions in order to obtain the best-fitting model. The two-class LCA solution provided the most parsimonious and stable model based on BIC values (Table 2). The Wald test yielded statistically significant values for each of the impulsivity measures, indicating that response profiles to these measures contribute to discriminate between classes.

In order to optimize participants' allocation to classes, we only classified those cases in which probability was superior to 60%. Following this criterion, we classified 93 cases (97%) and only 5 cases (3%) stood unclassified. Class 1, containing 53% of the sample, included individuals with high probabilities of elevated scores on the five dimensions of the UPPS-P (negative urgency = .72; positive urgency = .99; lack of premeditation = .76; lack of perseverance = .76; and sensation seeking = .83), longer Stroop inhibition times (.78), and lower d2 efficiency scores (.72). Class 2, containing 47% of the sample, included individuals with high probabilities of lower scores on the UPPS-P dimensions (negative urgency = .95; positive urgency = .92; lack of premeditation = .73, lack of perseverance = .83; and sensation seeking = .71), faster Stroop inhibition times (.69), and higher d2 efficiency scores (.74). The mean probability of pertaining to Class 1 was of .94 (range .6–1.0) and the mean probability of

Table 1. Descriptive scores of impulsivity, personality beliefs, and outcome measures in the traditional diagnostic groups

	Cocaine + Personality disorders	Cocaine	Gambling
Trait impulsivity			
Negative urgency	35.11 (5.2)	31.3 (6.82)	28.24 (6.06)
Premeditation	25.68 (6.56)	25.21 (4.97)	25.56 (4.74)
Perseverance	22.77 (4.97)	20.39 (4.41)	21.76 (5.56)
Sensation seeking	29.14 (7.62)	29.12 (8.25)	28.8 (6.28)
Positive urgency	33.83 (9.73)	31 (10.15)	28.44 (8.01)
Cognitive impulsivity			
d2 efficiency	407.42 (83.66)	416.36 (82.47)	434.28 (85.66)
Stroop inhibition	25.86 (17.23)	19.84 (10.48)	21.8 (12.47)
Dysfunctional beliefs			
Schizoid	24.69 (12.03)	21.31 (10.58)	14.33 (9.53)
Paranoid	22.03 (15.08)	17.06 (12.81)	14.5 (13.91)
Antisocial	27.1 (10.73)	24.58 (11.43)	20.33 (14.01)
Borderline	19.1 (9.89)	12.38 (9.19)	12 (13.57)
Histrionic	18.34 (10.35)	15.17 (7.4)	13.83 (10.95)
Narcissistic	18.17 (8.12)	15.59 (8.23)	10.25 (7.56)
Avoidant	19.34 (8.65)	14.83 (9.26)	13.25 (11.57)
Dependent	21.93 (11.22)	17.24 (8.97)	16.83 (15.44)
Obsessive-compulsive	26.24 (10.37)	23.31 (11.77)	18.33 (10.2)
Outcome measures			
Craving	8.06 (7.36)	6.17 (8.49)	4.31 (6.48)
Somatic symptoms	1.81 (1.76)	1.45 (1.78)	1.64 (2.13)
Anxiety	3.0 (2.45)	2.1 (2.38)	2.21 (2.36)
Social dysfunction	1.56 (2.26)	0.93 (1.58)	1.07 (1.86)
Depression	1.97 (2.44)	1.27 (2.17)	1.77 (2.31)
Quality of life	83.61 (10.5)	89.96 (11.78)	—

Note: Numbers represent means (*SD*).

Table 2. Fit measures for the estimated models

	BIC (LL)	AIC (LL)	Npar	Classification error
1-Model	5,221.39	5,185.20	14	0
2-Model	5,196.07	5,121.10	29	0.07
3-Model	5,198.05	5,084.31	44	0.10
4-Model	5,216.42	5,063.90	59	0.08
5-Model	5,248.73	5,057.44	74	0.06

Notes: BIC = Bayesian information criterion; AIC = Akaike information criteria; Npar = number of parameters.

pertaining to Class 2 was of .93 (range .6–1.0), indicating sound classification for most participants. Fig. 1 display the score profile of both classes on impulsivity measures.

Differences Between LCA-Derived Groups on Clinical and Outcome Measures

Class 1 ($n = 50$) was formed by 26 participants with cocaine use and personality disorders (52%), 16 participants with cocaine use disorders (32%), and 8 participants with gambling disorders (16%). Class 2 ($n = 43$) was formed by 9 participants with cocaine use and personality disorders (21%), 17 participants with cocaine use disorder, and 17 participants with gambling disorders (39.5%).

The two classes showed non-significant differences on relevant demographic variables or substance use patterns including tobacco, alcohol, cannabis, and cocaine use (Supplementary material online, Table S1). The two classes showed non-significant differences on adolescent substance use ($\chi^2 = 0.94, p > .1$) or ADHD diagnosis ($\chi^2 = 6.09, p > .1$). Classes did not either differ on lifetime prevalence of other Axis I disorders ($\chi^2 = 2.56, p > .05$). Cocaine users classified in Class 1 versus Class 2 did not differ on cocaine use parameters: Age at onset, monthly use, duration of use, recent use, or abstinence duration.

Results concerning clinical and outcome variables are presented in Table 3. The two classes showed statistically significant differences on the nine subscales of the PBQ, measuring degree of dysfunctional beliefs. The two classes also showed statistically significant differences on all the outcome measures: Craving, GHQ psychosocial measures (somatic symptoms, anxiety, social

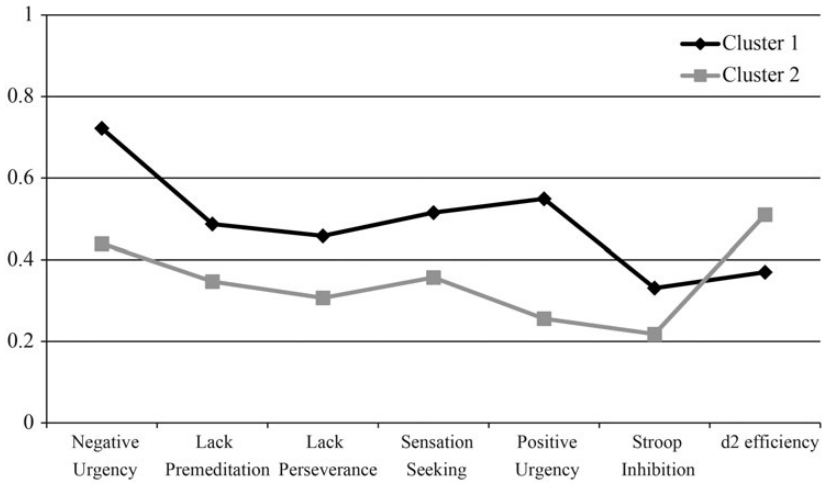

Fig. 1. Profile of impulsivity scores of the two classes after rescaling scores into a 0–1 scale.

Table 3. Descriptive scores and statistics for individuals classified in Class 1 and Class 2 on diagnostic composition, impulsivity, dysfunctional beliefs, and outcome measures

	Class 1	Class 2	*t*	*p*
Diagnostic composition	CB (34%), CC (18%), CO (16%), PG (32%)	CB (14%), CC (7%), CO (39.5%), PG (39.5%)		
Trait impulsivity				
Negative urgency	36.1 (4.71)	27.04 (4.92)	9.056	.000
Premeditation	27.52 (5.54)	23.11 (4.49)	4.164	.000
Perseverance	23.74 (4.27)	19.23 (4.72)	4.831	.000
Sensation seeking	31.52 (7.22)	26.16 (6.69)	3.689	.000
Positive urgency	37.04 (8.29)	24.79 (6.26)	7.932	.000
Cognitive impulsivity				
d2 efficiency	394.28 (79.05)	445.18 (81.1)	−3.059	.003
Stroop inhibition	26.5 (16.76)	18.13 (7.86)	2.997	.004
Dysfunctional beliefs				
Schizoid	26.05 (11.01)	15.81 (9.45)	4.112	.000
Paranoid	24.69 (13.26)	11.13 (11.3)	4.530	.000
Antisocial	27.48 (11.04)	21.64 (11.8)	2.128	.037
Borderline	20.67 (9.55)	8.09 (7.59)	5.974	.000
Histrionic	19.12 (9.61)	12.65 (7.86)	3.034	.003
Narcissistic	18.84 (8.19)	11.83 (7.09)	3.771	.000
Avoidant	20.97 (9.03)	10.7 (7.05)	5.190	.000
Dependent	22.48 (11.3)	14.87 (9.87)	2.957	.004
Obsessive-compulsive	26.67 (10.2)	19.9 (11.29)	2.627	.011
Outcome measures				
Craving	9.16 (8.47)	3.56 (5.26)	3.373	.001
Somatic symptoms	2.26 (1.99)	0.88 (1.27)	3.651	.001
Anxiety	3.51 (2.42)	1.29 (1.78)	4.561	.000
Social dysfunction	1.83 (2.27)	0.5 (1.11)	3.307	.002
Depression	2.51 (2.58)	0.6 (1.32)	4.108	.000
Quality of life	81.38 (10.25)	94.46 (8.99)	5.101	.000

dysfunction, and depression), and quality of life. In all cases, Class 1 showed significantly elevated clinical symptoms and poorer outcomes.

Discussion

LCA results showed that, in accordance with impulsivity scores, the three addiction diagnostic groups are best represented as two separate classes: Class 1 characterized by greater trait impulsivity and poorer cognitive impulsivity performance and

Class 2 characterized by lower trait impulsivity and better cognitive impulsivity performance. The two empirically derived Classes showed significant differences on personality features and outcome variables (Class 1 exhibited greater personality dysfunction and worse clinical outcomes), whereas conventional diagnostic groups showed non-significant differences on most of these measures. Of note, these profiles emerged in the absence of significant differences on patterns of substance use between Classes. All in all, our results support the value of impulsivity measures to identify trans-diagnostic subgroups of addicted individuals with different personality features and clinical outcomes.

Our first finding indicates that the highly impulsive Class 1 is characterized by greater levels of personality dysfunction. Previous studies on conventional diagnostic groups have yielded controversial results, since comorbidity between addiction and personality disorders has been associated with both increased (Albein-Urios et al., 2013) and decreased impulsivity levels (Vassileva, Gonzalez, Bechara, & Martin, 2007) probably due to inherent heterogeneity within these samples. Conversely, LCA-derived subgroups based on impulsivity are better suited to address this heterogeneity and therefore to provide better proxies of personality dysfunction, represented both by diagnostic composition (there were significantly more personality disorders diagnoses in Class 1) and by dimensional levels of personality beliefs (dysfunctional beliefs were significantly increased in Class 1). Between-class differences on dysfunctional beliefs corresponded not only to the personality disorders represented in the sample (Cluster B and Cluster C) but also to Cluster A's paranoid or schizoid disorders. The fact that classes did not discriminate between Cluster B and Cluster C diagnoses but clearly differentiated between high versus low levels of dysfunctional beliefs (relevant to several disorders) support the notion that these classes represent proxies of global psychosocial functioning (Kuyken, Kurzer, DeRubeis, Beck, & Brown, 2001). These results are also in line with those of previous studies that have successfully applied LCAs to identify subgroups of cocaine-dependent individuals with higher temperamental vulnerabilities and greater psychosocial stressors (Bornovalova et al., 2010).

The second main finding indicates that the highly impulsive Class 1 is characterized by poorer functioning across the different outcome measures: Increased levels of craving, worse psychosocial functioning, and lower perceived quality of life. These findings agree with previous evidence showing that higher impulsivity is significantly associated with greater severity of symptoms and greater psychological and social burden in cocaine use and gambling diagnostic groups (Bornovalova et al., 2010; Ledgerwood & Petry, 2010). We expand these findings by demonstrating that trait and cognitive impulsivity measures are useful to characterize clinically meaningful subgroups of addicted individuals with different clinical profiles. Impulsivity-based classes may therefore contribute to identify addicted individuals in need of tailored interventions (Friedmann Hendrickson, Gerstein, & Zhang, 2004). Because decreases in impulsivity are a mediator of the association between addiction treatment and recovery of psychosocial outcomes (Blonigen, Timko, Finney, Moos, & Moos, 2011) both direct and indirect interventions to tame impulsive behavior are warranted within this group. Due to the link between impulsivity and a number of clinical and psychosocial deficits, the interventions directed to this subgroup should prioritize those areas in which patients experience higher needs and subsequently translate these deficits into meaningful treatment goals (Miller & Miller, 2009).

Our findings should be appraised in the context of several considerations. First, the cocaine group included users with personality disorders, whereas the gambling group had not a comorbid parallel group and this stands as a limitation of the study. The main reason for not including this fourth group was the high rate of comorbid Axis I and Axis II disorders within the gambling population (Giddens, Stefanovics, Pilver, Desai, & Potenza, 2012) and the resulting lower prevalence of personality disorders in the absence of Axis I disorders. Second, we did not use a comprehensive assessment of impulsivity, but we specifically selected those measures previously associated with higher severity of personality dysfunction and poorer outcomes in cocaine and gambling disorders. Moreover, the cognitive measures selected have demonstrated significant associations with trait impulsivity indices in previous research (Cyders & Coskunpinar, 2011; Perales, Verdejo-García, Moya, Lozano, & Pérez-García, 2009). Third, a particular limitation of the sample was the reduced proportion of women, which is reflective of population prevalence, but clearly limits generalization of findings to female addicted populations. Fourth, we had a relatively small sample size. Nonetheless, although LCA models are typically used in larger samples, there is no consensus about the minimum sample size required for these models. In fact, the stability of LCA relies largely on other factors, such as sample homogeneity, number of predictive variables included in the model, and balance between class size and number of classes (Swanson, Lindenberg, Bauer, & Crosby, 2011). Considering these criteria, the LCA approach was well suited for this sample, since participants had homogeneous addiction-related diagnoses; we used theory-driven selected predictors; a small number of cases were discarded due to ambiguity in class membership; and models yielded low estimation errors and high probabilities of cluster fit. Nonetheless, future studies with larger sample sizes are warranted to corroborate the existence of these classes. All in all, the relevance of the study lays in the application of LCA to the impulsivity scores of this carefully characterized clinical sample, and the extraction of impulsivity data-driven subgroups differing on personality features and clinical outcomes. LCA is a model-based approach, such that its results are thought to be applicable to the population from which the data sample is extracted (Magidson & Vermunt, 2002), supporting the robustness of our findings.

Supplementary material

Supplementary material is available at *Archives of Clinical Neuropsychology* online.

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Conflict of Interest

None declared.

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