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Redefining phenotypes in eating disorders based on personality: A latent profile analysis

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ABSTRACT

To conduct a latent profile analysis (LPA) in eating disorder (ED) patients using temperament and character (TCI-R) measures as indicators. 1312 ED patients including those with anorexia nervosa (AN), bulimia nervosa (BN) and EDNOS were assessed. The final LPA solution was validated using demographics, clinical variables, ED symptomatology (EDI-2) and impulsive behaviors. The best-fitting model consisted of a six-profile solution using the seven subscales of the TCI-R. These profiles were labeled: *"self-focused"*, *"inhibited"*, *"average"*, *"impulsive"*, *"adaptive"* and *"maladaptive"*. Validation analyses indicated that the *"inhibited"* and *"maladaptive"* profiles generally presented with the highest values for ED symptomatology and impulsive behaviors. Whereas high levels of Harm Avoidance and low levels of Novelty Seeking and Persistence characterized the *"inhibited"* profile, the *"maladaptive"* profile presented with low levels of Reward Dependence, Self-Directedness and Cooperativeness. The most favorable results on the other hand were exhibited by the *"adaptive"* profile, characterized by high scores on Reward Dependence, Self-Directedness, Cooperativeness and low levels on Novelty Seeking. Finally, when our six-profile solution was compared with the DSM-IV ED diagnoses, significant differences among profiles and ED diagnoses were observed. Our study shows that ED patients can be meaningfully grouped according to temperament and character.

1. Introduction

Personality has commonly been shown to be an important risk factor for Eating Disorders (EDs) (e.g., Lilenfeld et al., 2006) and an important predictor of outcome (Klump et al., 2004; Wagner et al., 2006). Only a small number of studies (e.g., Thompson-Brenner et al., 2008; Penas-Lledo et al., 2010) have attempted to classify ED patients according to personality. However these studies have generally used cluster analyses rather than more advanced statistical tools such as Latent Profile Analyses (LPA). In the present study, we applied LPA to meaningfully classify ED patients according to personality.

1.1. Cluster analyses of eating disorders

Given the problems inherent in the current classification system, various studies have used cluster analysis to explore natural groupings of ED symptoms empirically in both clinical (Turner and Bryant-Waugh, 2004; Penas-Lledo et al., 2009; Turner et al., 2010) and community samples (Gibson et al., 2008; Penas-Lledo et al., 2008). In general, classification studies have not always mapped neatly onto existing diagnostic categories suggesting a rather poor fit between empirically derived groupings of individuals and clinical diagnostic criteria (Clinton et al., 2004; Sloan et al., 2005).

1.2. Latent class analyses and latent profile analyses in eating disorders

Latent class analysis (LCA) and LPA are used to identify and model latent classes composed of similar cases in multivariate categorical data (LCA) and continuous data (LPA). Compared with cluster analysis, latent variable approaches are model-based and allow for estimation of error. Like cluster analysis, LCA and LPA have been used for ED classification in clinical (Sullivan et al., 1998; Keel et al., 2004; Mitchell et al., 2007; Eddy et al., 2009; Eddy et al., 2010) and community samples (Bulik et al., 2000a; Striegel-Moore et al., 2005; Wade et al., 2006; Eddy et al., 2009). Using these techniques, classes have been identified that resemble DSM-IV diagnostic categories; however,

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subthreshold appearances commonly clustered with full syndrome disorders (Sullivan et al., 1998; Keel et al., 2004; Eddy et al., 2009;).

1.3. Clusters of personality traits in eating disorders

Individuals with EDs may be meaningfully grouped according to the type and severity of accompanying personality pathology (Espelage et al., 2002; Claes et al., 2006; Thompson-Brenner et al., 2008; Boone et al., 2010; Hopwood et al., 2010). Cluster analytical studies of the personality traits in ED individuals have consistently revealed three clusters: 1.) *"Constricted/Overcontrolled"*, 2.)*"Dysregulated/Undercontrolled"* and 3.) a relatively high functioning-perfectionistic cluster (Goldner et al., 1999; Westen and Harnden-Fischer, 2001; Wonderlich et al., 2005; Holliday et al., 2006).

1.4. The temperament and character inventory (TCI-R, Cloninger, 1999)

A personality measure, which has commonly been employed in the ED literature (Klump et al., 2004; Jacobs et al., 2009), is the Temperament and Character Inventory (TCI-R; Cloninger, 1999). The TCI is based on Cloninger's (Cloninger, 1999) psychobiological personality model, which theorizes about four genetically independent and highly heritable temperamental personality traits: Novelty Seeking, Harm Avoidance, Persistence, and Reward Dependence and three character dimensions: Self-Directedness, Cooperativeness and Self-Transcendence. Various studies have indicated that specific personality traits, mainly elevated Harm Avoidance and low Self-Directedness and Cooperativeness were related to EDs (Fassino et al., 2002; Klump et al., 2004). Furthermore, Bulimia Nervosa (BN) and Anorexia Nervosa Binge-Purging (AN-BP) have often been associated with elevated Novelty Seeking (e.g., Fernandez-Aranda et al., 2009; Krug et al., 2009).

1.5. Latent profile analyses based on personality in eating disorders

To date, only two studies have used LPA to group ED patients according to personality (Wonderlich et al., 2005; Jacobs et al., 2009). Wonderlich et al. (2005) employed LPA to identify clusters of full and subthreshold BN patients based on psychiatric comorbidity and personality. Three clusters emerged, an *"affective-perfectionist"* cluster, an *"impulsive"* cluster and a *"low comorbid psychopathology"* cluster. Jacobs et al. (2009) successfully grouped AN patients and their parents into three classes according to both personality measures (Perfectionism, Neuroticism and Harm Avoidance) and ED symptomatology. The following classes emerged in patients: 1.) low symptoms; and 2.) heightened scores on Drive for Thinness, Body Dissatisfaction, Neuroticism, Trait Anxiety and Harm Avoidance and 3.) elevated levels on ED and anxious/perfectionistic traits. However, it should be noted that these two studies were limited to a specific ED diagnosis and in the second study only the Harm Avoidance subscale of the TCI-R was included.

1.6. The present study

The present study was designed to expand on the extant literature by examining the empirical validity and clinical meaningfulness of ED diagnoses by employing the TCI-R. LPA was used to empirically identify ED phenotypes in a large and well-characterized Spanish sample, including the entire spectrum of EDs [AN, BN EDNOS, and Binge Eating Disorder (BED)]. Previous studies have generally employed eating pathology as indicators in LPA analyses and have used other relevant psychological, physical, and behavioral symptoms as validators. However, to our knowledge, no study has yet attempted to capture whether ED subgroups can be adequately characterized by using the TCI-R subscales.

1.7. Aims of the study

The objectives of the present study were; 1.) to empirically evaluate subgroups within EDs using an LPA approach with a sample of treatment-seeking patients by using personality measures as indicators; 2.) to examine the final solution across a wide range of variables assessing demographics, clinical variables, ED symptomatology and impulsive behaviors and 3.) to assess the congruence between empirically and clinically derived ED subgroups by comparing the predictive validity of this approach with that of the DSM-IV scheme.

2. Methods

2.1. Participants

Entry into the study was between January-2002 and February-2009. The sample included 1312 ED patients consecutively admitted to the ED unit at the University Hospital of Bellvitge. All participants were diagnosed according to DSM-IV (APA, 2000) criteria, using a semi-structured clinical interview (SCID-I, First et al., 1996). The DSM-IV diagnostic breakdown in the current sample was: AN-Restricting (AN-R; $n=139$; 10.6%), AN Binge-Purging (AN-BP; $n=118$; 9.0%), BN Binge-Purging (BN-BP; $n=567$; 43.2%), BN Non-Purging (BN-NP; $n=55$; 4.2%), Binge Eating Disorder (BED; $n=61$; 4.6%), EDNOS-Restricting (EDNOS-R; $n=102$; 7.8%) and EDNOS-Binge/Purging (EDNOS-BP; $n=270$; 20.6%). The EDNOS-R group comprised patients who failed to meet criteria due to (a) BMI>17.5 kg/m^{2}or (b) presence of menses. The EDNOS-BP group included individuals who (a) did not meet the frequency threshold of binge eating and vomiting for BN or (b) presented with only purging behavior but not with binge eating behavior or c) did not meet the frequency threshold for binge eating episodes in order to be classified as BED.

For the present analysis, 96 male ED patients were excluded from an initial sample of 1408 patients, as the number of males was too small for meaningful LPA analyses. Inclusion/exclusion decisions were made by psychologists or psychiatrists who completed the assessment together with the treatment team according to published treatment guidelines (Fernández-Aranda and Turon, 1998). The Ethics Committee of our institution approved this study and informed consent was obtained from all participants.

2.2. Assessment

2.2.1. Evaluation of sociodemographic and clinical variables

Demographic information, including age, marital status, education, occupation, and clinical relevant variables, comprising weight, height, weekly frequency of binges, vomiting episodes, laxative use and diuretic use, number of previous treatments, age of onset and duration of the ED were assessed by a semi-structured clinical interview (Fernández-Aranda and Turon, 1998).

2.2.2. Eating Disorders Inventory-2 (EDI-2, Garner, 1991)

The EDI-2 is a reliable and validated 91-item multidimensional self-report questionnaire that assesses cognitive and behavioral characteristics associated with EDs. The EDI-2 contains eight scales: Drive for Thinness, Bulimia, Body Dissatisfaction, Ineffectiveness, Perfectionism, Interpersonal Distrust, Interoceptive Awareness, and Maturity Fears, as well as three provisional scales: Asceticism, Impulse Regulation, and Social Insecurity. All items use a 6-point Likert scale. This instrument was validated in a Spanish population (Garner, 1998) and had adequate internal consistency (Cronbach's α value = 0.63).

2.2.3. Temperament and character inventory-revised (TCI-R, Cloninger, 1999)

The TCI-R (Cloninger, 1999) is a 240-item, reliable, and validated questionnaire that measures seven dimensions of personality: four temperament (Harm Avoidance, Novelty Seeking, Reward Dependence and Persistence) and three character dimensions (Self-Directedness, Cooperativeness and Self-Transcendence). All items are measured using a 5-point Likert scale. The Spanish version of the TCI-R (Gutiérrez-Zotest et al., 2004) has an internal consistency (Cronbach's α) of 0.87.

2.2.4. Impulsive behaviors

The SCID-I (First et al., 1996) for DSM-IV Axis I Disorders was used to assess lifetime alcohol and drug abuse. In addition, self-harm, defined as direct and intentional self-injurious behaviors (cutting/burning/hitting/scratching/hair pulling) which did not lead to death and lifetime suicide attempts (with the question "have you ever attempted suicide?") was assessed by a semi-structured clinical interview (Fernández-Aranda and Turon, 1998).

2.3. Procedure

Experienced psychologists and psychiatrists with master or doctoral degrees completed the clinical assessment during two structured face-to-face interviews, before any psychological or pharmacological treatment was initiated. In addition to the clinical interview, demographic information was obtained through self-report questionnaires.

2.4. Statistical analyses

2.4.1. Latent profile analysis (LPA)

Latent profile models were estimated using Latent Gold 4.0 software (Vermunt et al., 2005). The LPA number of latent profiles is prespecified, in our case, from 1 to 8 latent profiles, and individuals with similar responses cluster together. Posterior probabilities are calculated for each individual for every latent profile and profile assignment is based on that for which the person has the highest probability. Model selection is based on the following goodness-of-fit indices: a) the Bayesian Information Criterion [BIC; (Schwarz, 1978)], which provides a measure of goodness of fit for comparing nested models; b) the Akaike Information Criterion [(Akaike, 1987); the lower the value, the better the fit] and c) entropy, which is an r-squared value that indicates how well one can predict classes. The closer these values are to 1, the better the predictions. Cases with missing data were included and handled using imputation methods incorporated in the Latent Gold software.

2.4.2. Validation of the classes

Validation analyses consisted of comparing the final LPA model on a series of variables relevant to EDs. These analyses were carried out with PASW 17 for Windows (SPSS Inc., Chicago, IL, USA). Comparisons between the latent profiles on the set of sociodemographic and clinical variables, ED symptomatology (EDI-2), and impulsive behaviors were carried out with analysis of variance (ANOVA) procedures for quantitative variables and chi-square tests for categorical variables. Effect size and association measures were based on eta-squared in ANOVA procedures (for quantitative criteria) and Nagelkerke's R^2 in logistic regressions (for binary criteria). Due to multiple comparisons, type-I error inflation was controlled using Finner's adjustment (Finner, 1993), obtained with SPSS macros (Domènech, 2008). Finner's adjustment is a modified (stepwise) Bonferroni method that uses a sequential procedure to adjust *p*-values with the aim of controlling Family Wise Error Rate (FWER) while retaining good power. While this Finner's adjustment was applied to the overall omnibus tests analyzed at once, post hoc comparisons were performed for those measures that showed statistically significant differences. In this case, the global alpha value for the whole set of contrasts (Scheffé method) was established at 0.01 level.

3. Results

3.1. Demographics and clinical variables

The majority of the sample was single (77.4%) and had not completed university education (71.0%). Less than half the patients were employed (41.2%). The mean age of the sample was 25.95 yrs (S.D. = 7.34). The mean age of onset of the ED was 19.19 yrs (S.D. = 6.36) and the mean duration of the disorder was 6.78 yrs (S.D. = 5.80). The mean number of previous treatments was 0.92 (S.D. = 1.24). Participants reported a weekly average of 4.7 binge eating episodes (S.D. = 6.5), 5.4 vomiting episodes (S.D. = 7.9), 3.9 laxative use episodes (S.D. = 14.2), and 1.4 diuretic misuse episodes (S.D. = 5.6). Mean BMI at assessment was 22.17 kg/m^2 (S.D. = 6.35).

3.2. Results of latent profile analyses

A series of 1- to 8-profile models were estimated, based on all seven TCI-R subscale scores. Table 1 indicates the BIC, AIC, and entropy values across the 1–8 profile solutions. The best fitting model corresponded to the six-profile model, which showed acceptable BIC value of 64614.87. The AIC value was lowest for the 8-profile model; however, provided that we wanted a parsimonious and clinically meaningful model and the AIC values after the sixth model decreased only in relatively small amounts, we decided to remain with the 6-class solution.

Table 1
BIC, AIC, and entropy values across the 1–8 profile solutions.

Profile	BIC	AIC	Entropy
1	65,089.25	65,019.49	1.00
2	64,535.39	64,385.91	0.64
3	64,419.18	64,189.97	0.66
4	64,303.98	63,995.04	0.67
5	64,239.19	63,850.53	0.70
6	64,231.64	63,763.25	0.71
7	64,251.82	63,703.71	0.73
8	64,280.43	63,652.59	0.74

Note. BIC = Bayesian Information Criterion; AIC = Akaite Information Criterion.

To help the interpretation of our findings we labeled the six profiles as follows: *"self-focused"*, *"inhibited"*, *"average"*, *"impulsive"*, *"adaptive"*, and *"maladaptive"*. The *"self-focused"* profile represented the largest ($n = 505$, 38.5% of sample) group of ED patients. The *"inhibited"* and *"average"* profiles were the second largest groups (profile *"inhibited"*: $n = 208$, 15.9% of sample; profile *"average"*: $n = 212$, 16.2% of sample). The lowest proportion of patients was in the *"maladaptive"* profile and comprised only 106 patients (8.1% of sample). Finally, the *"impulsive"* and *"adaptive"* profiles were the second smallest groups. The *"impulsive"* profile included 140 individuals (10.7% of sample) and the *"adaptive"* profile entailed 141 patients (10.7% of sample).

3.3. Profiles of latent classes

Table 2 presents means and standard deviations across indicator variables for the seven TCI-R subscales for each of the six profiles. Mean values for the different TCI-R subscales varied significantly across the six profiles. The *"inhibited"* profile exhibited the highest value for Harm Avoidance and the lowest values for Novelty Seeking and Persistence. The *"impulsive"* profile showed the highest values for Novelty Seeking, Persistence and the lowest values for Harm Avoidance. Furthermore together with the *"self-focused"*, profile, the *"impulsive"* profile showed the highest values for Self-Transcendence and together with the *"adaptive"* profile presented the highest values for Reward Dependence. The *"adaptive"* profile also revealed the highest values for Self-Directedness and also presented with high scores on Cooperativeness. On the other hand the *"maladaptive"* profile demonstrated the lowest values on Reward Dependence, Self-Directedness and Cooperativeness. Finally, the *"average"* profile revealed average values for all seven TCI-R personality subscales.

3.4. Validation analyses

Validation analyses were conducted using the final six-profile solution. Table 3 presents means and standard deviations for the validation indicators for each of the six profiles, including pairwise contrasts (p value < 0.01).

3.5. Clinical characteristics

Statistically significant differences across profiles only emerged for current BMI, with the *"maladaptive"* profile showing higher values than the *"average"* profile.

3.6. ED symptomatology

In relation to compensatory behaviors, individuals in the *"inhibited"* profile exhibited significantly more weekly binge eating episodes than patients in the *"adaptive"* profile. The weekly vomiting frequency was significantly higher in the*"self-focused"* profile compared to the *"adaptive"* profile. Lastly, the *"maladaptive"* profile demonstrated significantly higher weekly frequency of laxative use than the *"average"*, *"impulsive"* and *"adaptive"* profiles.

As regards to the EDI-2, the following differences emerged; the *"self-focused"*, *"inhibited"* and *"maladaptive"* profiles presented the highest values on Body Dissatisfaction, Bulimia, and Interoceptive Awareness. Interpersonal Distrust, Maturity Fears, Impulsivity, and Asceticism levels were also highest for the *"maladaptive"* profile. Furthermore the *"inhibited"* and *"maladaptive"* profiles also presented the highest values for Drive for Thinness, Ineffectiveness, and Social Insecurity. Conversely, the *"adaptive"* profile exhibited the lowest scores on all the EDI-2 subscales and the *"average"* and *"impulsive"* profiles revealed the second lowest values after the *"adaptive"* profile.

Table 2
Means and standard deviations (S.D.) for the indicators for the final profile solution.

	Mean (S.D.)								
Cluster Personality: TCI-R scores	1: *"self-focused"* ($n=505$)	2: *"inhibited"* ($n=208$)	3: *"average"* ($n=212$)	4: *"impulsive"* ($n=140$)	5: *"adaptive"* ($n=141$)	6: *"maladaptive"* ($n=106$)	Corrected p-value*	Effect size**	Contrasts
TCI-R-Novelty Seeking	106.40 (13.28)	94.67 (17.57)	98.32 (9.76)	117.79 (14.48)	95.53 (11.88)	107.22 (20.71)	<0.001	0.216	(2=3=5)<(1=6)<4
TCI-R-Harm Avoidance	121.30 (8.39)	141.96 (8.69)	111.32 (11.42)	94.96 (13.59)	101.38 (15.31)	124.77 (19.74)	<0.001	0.607	4<5<3<(1=6)<2
TCI-R-Reward Dependence	104.65 (13.74)	103.13 (13.34)	97.45 (9.47)	114.15 (11.48)	114.82 (13.73)	83.10 (14.17)	<0.001	0.330	6<3<(1=2)<(4=5)
TCI-R-Persistence	113.45 (16.92)	96.85 (22.37)	108.41 (15.72)	123.42 (20.52)	116.99 (17.83)	103.64 (25.66)	<0.001	0.158	2<3<5; 6<1<4
TCI-R-Self-Directedness	104.67 (8.54)	102.04 (16.32)	126.90 (9.25)	120.88 (12.53)	151.82 (11.16)	94.81 (18.58)	<0.001	0.664	6<(1=2)<4<3<5
TCI-R-Cooperativeness	130.96 (13.95)	140.74 (12.28)	135.14 (9.66)	142.74 (12.92)	150.46 (10.36)	101.08 (13.94)	<0.001	0.516	6<(1=3)<(2=4)<5
TCI-R-Self-Transcendence	72.59 (13.41)	60.94 (13.91)	60.73 (10.00)	75.36 (17.17)	61.44 (15.15)	63.26 (15.11)	<0.001	0.159	(2=3=5=6)<(1=4)

* p-values with Finner's correction for multiple comparisons.
** eta-square.
1 = *"self-focused"*; 2 = *"inhibited"*; 3 = *"average"*; 4 = *"impulsive"*; 5 = *"adaptive"*; 6 = *"maladaptive"*.

3.7. Impulsive behaviors

All impulsive behavior items differed significantly across some of the six profiles. For self-harm behaviors and suicide attempts, the lowest percentages were found for the *"adaptive"*, *"average"* and *"impulsive"* profiles, whereas the *"self-focused"*, *"inhibited"* and *"maladaptive"* profiles showed the highest values. As regard to alcohol abuse, the *"maladaptive"* profile exhibited the highest values, whereas the *"average"* and *"adaptive"* profiles presented with the lowest values. A similar pattern was observed for drug abuse, with the only difference that the *"self-focused"* and *"impulsive"* profiles presented, together with the *"maladaptive"* profile, the highest values.

3.8. Comparison of the six-class solution with the DSM-IV eating disorder diagnoses

Fig. 1 depicts the relationship between LPA profile membership and hierarchical DSM-IV diagnoses assigned to the ED patients. Significant differences emerged among diagnostic categories and latent profiles (p-values for overall model <0.001). Post-hoc comparisons indicated that a significant difference was observed for the diagnosis AN-R and BN-P, with significantly more AN-R women being in the *"average"* and *"adaptive"* profiles than in the other four profiles ($p<0.05$), and significantly more BN-P individuals in the *"self-focused"*, *"inhibited"*, and *"maladaptive"* profiles than in the *"average"* and *"adaptive"* profiles

Table 3
Means and standard deviations (S.D.) for the validation analyses for the final profile solution.

	Mean (S.D.) for quantitative variables and n (percentage) for binary measures								
Cluster Measures	1 = *"self-focused"* ($n=505$)	2 = *"inhibited"* ($n=208$)	3 = *"average"* ($n=212$)	4 = *"impulsive"* ($n=140$)	5 = *"adaptive"* ($n=141$)	6 = *"maladaptive"* ($n=106$)	Corrected p-value*	Effect size**	Contrasts
Clinical Variables									
Age of onset	18.63 (5.98)	19.29 (6.34)	19.72 (6.75)	18.46 (5.97)	20.73 (7.30)	19.09 (5.98)	0.016	0.012	None
Duration of the disorder (years)	6.75 (5.65)	7.60 (6.20)	6.12 (5.78)	7.02 (5.46)	5.75 (5.42)	7.77 (6.31)	0.020	0.012	None
Current BMI	22.77 (6.44)	22.73 (6.48)	20.79 (5.99)	21.40 (4.51)	21.30 (7.60)	23.75 (6.08)	<0.001	0.022	3<6
Eating Disorder Symptomatology									
Frequency of Binge Eating	5.42 (6.53)	5.81 (7.49)	3.76 (6.39)	4.35 (5.56)	3.04 (5.32)	4.54 (5.94)	<0.001	0.021	5<2
Frequency of Vomiting	6.65 (8.70)	5.62 (8.42)	4.13 (7.12)	4.95 (6.44)	3.22 (6.35)	5.42 (7.72)	<0.001	0.022	5<1
Frequency of Laxative Use	4.42 (16.61)	3.74 (8.78)	2.84 (8.70)	2.39 (6.32)	1.97 (6.33)	9.01 (28.05)	0.002	0.016	3<6; 4<6; 5<6
EDI-II-Drive for Thinness	13.93 (5.59)	15.49 (5.14)	11.70 (6.31)	13.39 (6.15)	9.08 (6.72)	14.62 (5.85)	<0.001	0.094	5<all; 3<(2=6)
EDI-II-Body Dissatisfaction	17.68 (7.43)	20.06 (6.83)	14.39 (7.75)	14.07 (7.63)	11.81 (7.62)	19.33 (7.09)	<0.001	0.117	(3=4=5)<(1=2=6)
EDI-II-Interoceptive Awareness	13.30 (6.23)	15.26 (5.83)	8.74 (5.35)	10.24 (5.73)	5.54 (5.09)	14.98 (6.34)	<0.001	0.226	5<(3=4)<(1=2=6)
EDI-II-Bulimia	8.07 (5.72)	8.60 (6.10)	5.38 (5.27)	6.86 (5.46)	3.87 (4.50)	9.45 (5.86)	<0.001	0.085	5<all; 4<(1=2); 4<6
EDI-II-Interpersonal Distrust	6.02 (4.27)	8.16 (4.42)	5.93 (3.60)	2.88 (3.33)	2.97 (3.18)	10.59 (5.21)	<0.001	0.221	(4=5)<(1=3)<2<6
EDI-II-Ineffectiveness	12.41 (5.88)	17.01 (6.26)	8.12 (5.28)	7.47 (5.18)	4.73 (4.53)	15.08 (7.02)	<0.001	0.319	5<(3=4)<1<(2=6)
EDI-II-Maturity Fears	8.56 (5.50)	10.46 (6.01)	6.04 (4.20)	6.68 (4.58)	5.24 (4.35)	11.55 (6.64)	<0.001	0.123	(3=4=5)<2<6
EDI-II-Perfectionism	6.23 (4.33)	6.52 (4.32)	3.81 (3.38)	6.41 (4.91)	4.07 (3.77)	7.33 (5.03)	<0.001	0.072	(3=5)<(1=2=4=6)
EDI-II-Impulsivity	8.52 (5.64)	9.52 (5.92)	4.38 (3.99)	5.48 (4.76)	2.49 (3.41)	12.81 (6.86)	<0.001	0.253	5<4<(1=2)<6
EDI-II-Asceticism	7.62 (4.02)	8.98 (3.80)	5.24 (3.51)	6.57 (3.89)	4.26 (3.50)	9.78 (4.96)	<0.001	0.171	5<4<2; 3<1<6
EDI-II-Social Insecurity	8.80 (4.05)	11.45 (4.37)	7.24 (4.21)	4.63 (3.40)	3.61 (3.55)	12.61 (4.58)	<0.001	0.337	(4=5)<(1=3)<(2=6)
Impulsive Behaviors									
Self-harm behaviors	145 (38.2%)	81 (43.1%)	39 (19.4%)	33 (25.6%)	19 (14.6%)	45 (45.9%)	<0.001	0.077	(3=4=5)<(1=2=6)
Suicide attempts	120 (29.3%)	52 (27.4%)	28 (13.9%)	25 (19.5%)	10 (7.7%)	37 (37.8%)	<0.001	0.069	(3=4=5)<(1=2=6)
Alcohol Abuse	58 (14.1%)	22 (11.6%)	8 (4.0%)	21 (16.5%)	3 (2.3%)	26 (26.5%)	<0.001	0.084	(3=5)<(1=2=4)<6
Drug Abuse	94 (22.8%)	34 (17.9%)	20 (10.0%)	34 (27.0%)	18 (13.8%)	28 (28.6%)	<0.001	0.038	(2=3=5)<(1=4=6)

* p-values with Finner's correction for multiple comparisons.
** eta-square for quantitative measures and Nagelkerke's R-square for binary measures.

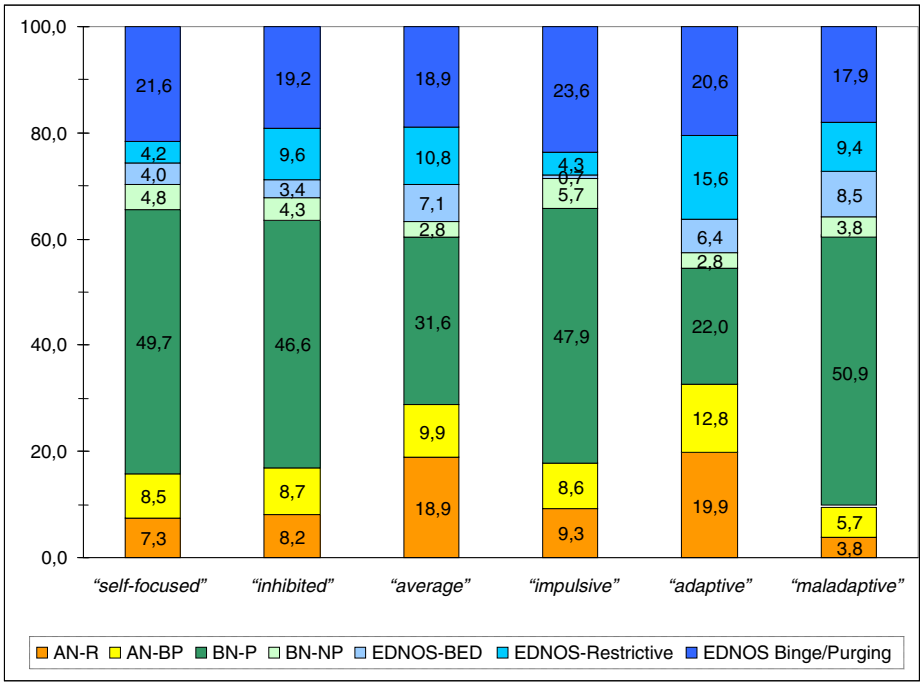

Fig. 1. Comparison of classes with DSM-IV eating disorder diagnoses.

($p<0.05$). As regards to EDNOS-BED we revealed that this group was represented more frequently in the *"average"*, *"adaptive"* and *"maladaptive"* profiles and least in the *"impulsive"* profile ($p<0.05$). Finally, EDNOS-R was significantly less commonly represented in the *"self-focused"* profile than in the *"inhibited"*, *"average"* and *"adaptive"*profiles, and also more commonly represented in the *"adaptive"* profile than the *"impulsive"* profile ($p<0.05$). The remaining diagnostic categories were distributed similarly across profiles (data of all *p*-value comparisons can be provided upon request).

4. Discussion

To our knowledge, this is the first study to assess how meaningful profiles within ED treatment-seeking patients can be obtained through LPA analyses by using temperament and character (TCI-R) variables as indicators. Four main findings emerged from the present study. Our first finding was that the most parsimonious and best fitting LPA model was a six-profile solution based on the seven subscales from the TCI-R scale. The second main finding was that the six profiles differed significantly from each other on most of the validation variables. Our third finding was that generally the *"inhibited"* and *"maladaptive"* profiles presented with significantly higher scores on ED symptomatology and impulsive behaviors, whereas the *"adaptive"* profile normally exhibited the lowest values on these measures. Finally, comparison of the six-profile solution with the DSM-IV ED diagnoses revealed significantly different distributions across the six profiles of patients for AN-R, BN-P, BED and EDNOS-R subtypes.

4.1. Best fitting LPA model

Our first finding was that distinct subgroups of ED patients can be identified using the TCI-R subscales. To date, no empirically derived TCI-R profile model on a representative distribution of ED patients has been reported in the literature. Our finding of a six-profile solution based on personality is in agreement with prior studies (e.g., Espelage et al., 2002; Wonderlich et al., 2005; Thompson-Brenner et al., 2008; Jacobs et al., 2009) that have indicated that personality variables are good indicators for categorizing ED groups. However, it should be noted that while all of these studies had obtained a three clusters, our study revealed a six-profile solution.

Even though the present study yielded substantially more profiles than previous studies, most of our profiles revealed important similarities with previous formulations. In agreement with other studies (e.g., Goldner et al., 1999), we also obtained two profiles, the *"self-focused"* and *"average"* profiles, with average values on most TCI-subscales. Our *"inhibited"* and *"impulsive"* profiles reveal important similarities to the *"Constricted/Overcontrolled"* and*"Dysregulated/Undercontrolled"* clusters that have commonly been reported in the literature (Goldner et al., 1999; Westen and Harnden-Fischer, 2001; Espelage et al., 2002; Wonderlich et al., 2005). Finally, the *"adaptive"* and *"maladaptive"* profiles appear to be new profiles that have not been identified previously. It is possible that some of the differences between our profile structure and the ones from others are related to the inconsistencies across studies in terms of sampling methods and the different personality assessments employed.

4.2. Validation analyses of the six-profile solution

4.2.1. Clinical variables

The second main finding of our study was that the six profiles differed significantly from each other on some clinical variables. Regarding weight, we found that BMI was highest for the *"maladaptive"* profile. This finding is in accordance with earlier studies (e.g., Penas-Lledo et al., 2010), which have found that maladaptive personality traits, especially impulsive traits, are related to binge eating, which in turn has commonly been associated with overweight/obesity (Wonderlich, et al., 2009).

4.2.2. ED symptomatology

The third main finding of the present study was that the validity of our LPA approach to incorporate multiple personality dimensions is supported by the strong positive associations that were found between the *"inhibited"* and the *"maladaptive"* profiles and ED symptomatology. Conversely, the *"adaptive"* profile generally presented with the lowest values for these measures. In line with our findings, previous studies have shown that maladaptive personality traits were associated with a more severe ED pathology (Keel et al., 2004; Wade et al., 2006; Spindler

and Milos, 2007; Grilo et al., 2009) and higher drop-outs from treatment (Fassino et al., 2009). Contrastingly, a positive relationship between an increase in Self-Directedness and Cooperativeness and symptomatic reduction in purging frequency has commonly been reported (Bulik et al., 1998; Anderson and Maloney, 2001; Dalle Grave et al., 2007). Furthermore, Self- Directedness has been found to predict a more rapid and substantial response to Cognitive Behavior Therapy (CBT) (Bulik et al., 1999; 2000b) and has been shown to improve after therapy (Anderson and Maloney, 2001). Self-Directedness has also commonly been related to the concept of self-efficacy (Cloninger, 1999), which has been shown to play an important role in the development, maintenance, coping and treatment of EDs (e.g., Steele et al., 2010).

4.2.3. Impulsive behaviors

In terms of impulsive behaviors, our results are partially in concordance with earlier research, in that the *"maladaptive"* profile was related to impulsive behaviors (Bulik et al., 2008; Fernandez-Aranda et al., 2009). However, in contrast to previous cluster studies of personality in EDs (Westen and Harnden-Fischer, 2001; Espelage et al., 2002; Wonderlich et al., 2005; Claes et al., 2006), which found that undercontrollers showed more alcohol/drug abuse than the over-controllers, we found that high levels of Harm Avoidance *("inhibited"* profile) and low scores on Reward Dependence *("maladaptive"* profile) were related to impulsive behaviors. Some studies (e.g., Bulik et al., 2008; Forcano et al., 2009) assessing suicide attempts and/or self-harming behaviors in EDs have indicated that both impulsive as well as avoidant personality traits were related to these behaviors. This combination may therefore converge to increase the risk for suicide and self-harming behaviors in EDs. Finally, it could also be argued that elevated Harm Avoidance scores may be related to higher individual and social insecurity, which in turn might be related to more impulsive behaviors. The impulsive behaviors might therefore be a consequence of the primary deficit of insecurity.

4.3. Comparison of the six-profile solution with the DSM-IV ED diagnoses

When comparing the six-profile solution to the DSM-IV diagnoses, significant differences across ED diagnoses emerged, which is in agreement with some studies (e.g., Goldner et al., 1999; Claes et al., 2006), but contradicts others (e.g., Espelage et al., 2002), which have found that cluster membership was not related to ED subtype.

The finding that BN-P was included in the *"impulsive"* and *"maladaptive"* profiles, is in accordance with previous studies, which have indicated that BN patients are characterized by high levels of comorbidity, Harm Avoidance, general psychopathology and distress (Fassino et al., 2002; Fernandez-Aranda et al., 2006) .

The finding that AN–R and EDNOS-R presented a similar pattern with an overrepresentation in the *"adaptive"* profile suggests that a distinction between these two ED groups may not be necessary as also shown in earlier studies (Eddy et al., 2002; 2008).

The high representation of ED patients with restrictive symptomatology in the *"adaptive"* profile is unexpected and may imply that these patients are in denial of their symptoms as frequently reported in community samples (Wade et al., 2006; Eddy et al., 2008) but less so with treatment-seeking samples (Eddy et al., 2009). Furthermore, our results are in accordance with the findings of earlier LPA studies (Mitchell et al., 2007; Eddy et al., 2009) assessing EDNOS patients, which revealed an underweight group denying psychopathology. However, it could also be the case that these patients do actually display lower levels of harmful symptoms and distress (Eddy et al., 2009) or that low weight serves to suppress depression, anxiety and other maladaptive personality traits.

4.4. Limitations

Our results should be interpreted in the context of methodological limitations. First, because a cross-sectional design was employed, temporal ordering of study variables and their causal interferences could not be assessed. Second, our findings were limited to the use of self-report questionnaires. Third, the generalizability of our findings is restricted both by the indicators used in the LPA and by the patient sample. These limitations are offset by the advantages of a large clinical sample comprising different ED diagnoses and the application of LPA using indicators that are not restricted to existing DSM-IV diagnostic criteria.

4.5. Implications

Our findings might have implications beyond nosology by indicating that ED patients may exhibit considerable variation in temperament and character domains as measured by the TCI-R. The results may therefore suggest the importance of examining different personality traits in relation to each other rather than in isolation. Moreover, our observations may support the usefulness of personality profiles in phenotype refinement and may emphasize the vital connections between temperament and character and ED related psychopathology.

With reference to treatment, personality-based clusters in EDs may be valuable enrichments to our current diagnostic system. They provide a richer descriptive profile that helps contextualize the ED symptoms within the backdrop of personality functioning. Such richness of conceptualization could aid in assessing the level of functioning and clinical course (Westen and Harnden-Fischer, 2001) and in tailoring interventions to particular personality clusters. In specific, our findings for example indicate that pre-treatment Self-Directedness and Cooperativeness scores could be helpful in planning treatment. Accordingly, interventions in EDs should be designed to address treatment needs along a continuum of problem behavior, including personality, not just eating behaviors.

Several unanswered questions remain for future study. First, independent replication and validation studies are needed to support the utility of our derived six-profile solution. Furthermore, longitudinal studies assessing the stability of these profiles over time are required. Finally, provided that temperament has been conceptualized as a genetically influenced building block of personality, future studies should also include behavioral susceptibility (e.g., neuropsychological functioning, biochemical and genetic variables) to assess profile membership based on personality in ED patients.

In summary, this study identified a six-profile solution based on the seven subscales of the TCI-R. The meaningfulness of our latent profiles is supported by the strong associations between membership and a broad range of ED related psychopathology. ED patients in the *"inhibited"* and *"maladaptive"* profiles generally exhibiting the highest values for ED related psychopathology, whereas individuals in the *"adaptive"* profile presented with the lowest values. Finally, the finding that our profiles mapped on some of the ED diagnoses included in the DSM-IV, add to the hotly debated topic of classification of EDs for the DSM-V.

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