Classifying Eating Disorders Based on "Healthy" and "Unhealthy" Perfectionism and Impulsivity

Margarita C.T. Slof-Op 't Landt, PhD[1]*
Laurence Claes, PhD[2,3]
Eric F. van Furth, PhD[1,4]

ABSTRACT

Objective: Perfectionism and impulsivity are associated with eating disorders (EDs). The current study examines whether clinically relevant subgroups of women with EDs can be identified based on "healthy" and "unhealthy" perfectionism and impulsivity.

Method: Latent profile analyses (LPA) were performed on data of 844 patients (DSM-IV diagnosis: 381 anorexia nervosa, 146 bulimia nervosa, 56 binge-eating disorder, 261 ED not otherwise specified). "Healthy" and "unhealthy" forms of perfectionism and impulsivity were assessed by the Frost Multidimensional Perfectionism Scale and the Dickman Impulsivity Inventory, respectively. The Eating Disorder Examination Questionnaire was completed to assess ED psychopathology. Furthermore, in 229 patients additional ED symptoms, depression, self-esteem, obsessive-compulsive symptoms, and personality features were assessed.

Results: The LPA revealed four profiles; 1. "Healthy Impulsivity" (HI; $n = 191$), 2. "Unhealthy Impulsivity" (UI; $n = 238$), 3. "Healthy and Unhealthy Perfectionism" (HP + UP; $n = 153$), 4. "Healthy Perfectionism" (HP; $n = 262$). Patients belonging to the

"HP + UP" and the "UI" classes reported higher levels of ED psychopathology. More severe comorbid symptoms (depressive, obsessive-compulsive and self-esteem) were found in the patients belonging to the "HP + UP" class. Patients from the "HP + UP" and "HP" classes had higher scores for the personality features Harm Avoidance, Persistence and Cooperativeness.

Discussion: Women with EDs could be meaningfully grouped according to perfectionism and impulsivity. These findings can be used to improve treatment matching and intervention strategies. The use of dimensional features, like perfectionism and impulsivity, in ED research, may enable the identification of fundamental underlying mechanisms and provide more insight into potential mechanisms that may drive or maintain disordered eating. © 2016 Wiley Periodicals, Inc.

Keywords: eating disorders; perfectionism; impulsivity; latent profile analyses

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Introduction

The personality features perfectionism and impulsivity are implicated in EDs. Perfectionism was shown to predict onset of inappropriate compensatory behaviors[1] and the onset and maintenance of

EDs.[2] It consistently characterizes patients with an ED, especially patients with anorexia nervosa (AN) and bulimia nervosa (BN).[3,4] Impulsivity, on the other hand, differentiates between ED subtypes; patients with an ED characterized by bingeing and/or purging tend to show more impulsivity than controls, whereas patients with restricting type AN tend to be less impulsive.[5] This feature is associated with poorer prognosis in both AN as well as BN.[6,7] Despite the supposedly opposite nature of perfectionism (overcontrolled personality feature) and impulsivity (undercontrolled personality feature), a substantial proportion of patients with an ED is affected by a combination of both features.[8]

Perfectionism and impulsivity are both multidimensional constructs.[9,10] In general, these dimensions can be split into "healthy" and "unhealthy" variants. Previously, perfectionism was divided into the "healthy" personal striving and the "unhealthy"

maladaptive evaluative concerns component.[11,12] Impulsivity is the tendency to act with little or no forethought, reflection or consideration of the consequences. For "unhealthy" impulsivity the consequences of this lack of deliberation are undesirable, for example not being able to keep appointments, making plans that do not work out or buying things without being able to afford them. However, there are situations when impulsivity has positive or "healthy" consequences, for example taking advantage of unexpected opportunities, being able to put thoughts into words rapidly or making split-second decisions easily.[13]

One study has previously examined the interplay between perfectionism (personal striving and evaluative concerns) and impulsivity in relation to ED symptoms in a healthy adolescent sample.[14] A combined perfectionism/impulsive cluster was identified in addition to a pure perfectionism, a pure impulsivity and a resilient cluster. Participants who belonged to the combined cluster showed the highest level of ED psychopathology.

The current study aimed to simultaneously investigate (a) whether we could define clusters of ED patients based on the interplay between "healthy" and "unhealthy" perfectionism and impulsivity, and (b) whether we could validate these clusters by comparing them with respect to ED psychopathology, comorbid psychopathology (e.g., depression and obsessive-compulsive symptoms) and personality features in a large sample of patients with EDs ($n = 844$). Implementing personality-based clusters in EDs, besides or in combination with diagnostic categories, can be a valuable enrichment for both treatment and research. These clusters give a richer descriptive profile that can improve treatment matching and can be used to gain insight into potential mechanisms that may drive or maintain EDs. We expected to identify similar clusters as the study in the healthy adolescents[14]; namely a pure impulsivity cluster ("healthy" and "unhealthy"), a pure perfectionism cluster ("healthy" and "unhealthy"), a combined cluster ("healthy" perfectionism, "unhealthy" perfectionism and "unhealthy" impulsivity), and a resilient cluster. The combined cluster was expected to have the highest level of ED and comorbid psychopathology.

Method

Participants

At 10 specialist ED units throughout the Netherlands, consecutive patients who were seeking treatment (resi-

dential, day as well as outpatient) for their ED were asked to participate in the GenED study.[15] A total of 844 female patients with a DSM-IV ED took part in this study. ED diagnoses were made by experienced clinicians based on a semi-structured interview at intake, and cross-validated by the self-report Eating Disorder Examination Questionnaire (EDE-Q[16]). The majority of patients ($n = 381$) had AN (190 restricting, 120 binge-eating/purging, 71 subtype not available), 146 patients had BN, 56 patients had a binge-eating disorder (BED) and 261 patients had an ED not otherwise specified (EDNOS; 119 belonged to the AN-spectrum and 51 to the BN-spectrum). Patients with a diagnosis of AN or BN were invited to participate in the second part of the study, 229 patients (135 AN, 94 BN) consented. This subsample completed additional self-report questionnaires. The study was approved by the ethics committee for mental health institutions in the Netherlands (METiGG). All participants gave written informed consent.

Measures

Perfectionism. The Multidimensional Perfectionism Scale[17] is a 35-item questionnaire using a Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"). It distinguishes six dimensions of perfectionism (concern over mistakes, personal standards, parental expectations, parental criticism, doubt about actions, and organization). Stumpf and Parker[11] performed a hierarchical structural analysis on this scale and identified two forms of perfectionism; "healthy" perfectionism (comprised of personal standards and organization) and "unhealthy" perfectionism (comprised of concern over mistakes, parental expectations, parental criticism and doubt about actions). In our sample, "healthy" and "unhealthy" perfectionism showed an excellent internal consistency, with a Cronbach's alpha of 0.91 and 0.94, respectively.

Impulsivity. The Dickman Impulsivity Inventory[13] is a 23-item questionnaire with responses in a true/false answer format. This instrument distinguishes two forms of impulsivity: Dysfunctional Impulsivity (the tendency to engage in rapid, error-prone information processing in situations where this is non-optimal) and Functional Impulsivity (the tendency to engage in rapid, error-prone information processing when such a strategy is rendered optimal). An example item of Dysfunctional Impulsivity is "I will often say whatever comes into head without thinking first" and for Functional Impulsivity "I am good in taking advantage of unexpected opportunities, where you have to do something immediately or lose your chance". In the current study we used Functional Impulsivity as "healthy" impulsivity and Dysfunctional Impulsivity as "unhealthy" impulsivity. Cronbach's alpha was

0.77 for "healthy" impulsivity and 0.85 for "unhealthy" impulsivity.

Eating Disorder Psychopathology. In addition to DSM-IV ED diagnoses, data on body mass index, based on current and lifetime lowest weight, were present for all participants.

The EDE-Q is a self-report questionnaire for the assessment of ED-specific psychopathologies.[16] It provides a comprehensive profile of individual psychopathology based on 22 items. Items are rated on 7-point forced-choice scales (0–6), with higher scores reflecting greater severity or frequency. An EDE-Q global scale can be computed to assess overall eating pathology. The EDE-Q global scale was assessed in all participants with an excellent internal consistency (Cronbach's alpha = 0.92).

The Eating Disorder Inventory-2 (EDI-2) is a 91-item self-report questionnaire, with responses on a 6-point rating scale ("never" to "always"), to assess psychological and behavioral characteristics thought to be involved with EDs.[18] The EDI-2 distinguishes eleven subscales; Drive for Thinness, Bulimia, Body Dissatisfaction, Ineffectiveness, Perfectionism, Interpersonal Distrust, Interoceptive Awareness, Maturity Fears, Ascetism, Impulse Regulation and Social Insecurity. EDI-2 data was available for a subsample of the patients ($n = 229$). In the current study, three subscales (Drive for Thinness, Bulimia and Body Dissatisfaction) were used to investigate core ED psychopathology. Internal consistency for these subscales was good to excellent (Cronbach's alpha was 0.89 for Drive for Thinness, 0.95 for Bulimia and 0.90 for Body Dissatisfaction). Furthermore, the EDI-2 subscales Perfectionism and Impulse Regulation, were used to check whether the identified classes based on "healthy" and "unhealthy" perfectionism and impulsivity also differed in alternative perfectionism and impulsivity measures. For these two subscales Cronbach's alpha was 0.81 and 0.75, respectively.

Comorbid Psychopathology. In the current study, data on comorbid psychopathology was available for a subsample of 229 patients. The Beck Depression Inventory (BDI[19]) is a 21-item self-report rating inventory measuring characteristic attitudes and symptoms of depression. Each item contains four self-evaluative statements rated on severity (0–3). The total BDI score ranges from zero to 63, with high scores indicating more severe depression symptoms. A Cronbach's alpha of 0.89 was found for BDI in the subsample.

The Padua Inventory-revised (PI-R[20]) is a self-report questionnaire to evaluate a person's tendency to worry and doubt (obsessions) and perform behaviors intended to ward off those doubts (compulsions), in five main areas: impulses, washing, checking, rumination and precision. The inventory consists of 41 items, each with five

TABLE 1. Correlations, means, standard deviations, and ranges of the indicator variables

	HP	UP	HI	UI
HP				
UP	0.59***			
HI	−0.19***	−0.32***		
UI	−0.24***	0.05**	0.10	
Mean (SD)	48.4 (10.6)	61.0 (18.7)	4.0 (2.8)	3.3 (3.3)
Range	[13.0;65.0]	[22.0;110.0]	[0;11.0]	[0;12.0]

***$p < 0.001$.
**$p < 0.01$.
HP = healthy perfectionism, UP = unhealthy perfectionism, HI = healthy impulsivity, UI = unhealthy impulsivity.

response levels. The PI-R total sore that ranges between zero and 164, was used in the current study. The internal consistency of the PI-R in this study was excellent, with a Cronbach's alpha of 0.94.

The Rosenberg Self-Esteem Scale[21] is a self-report questionnaire consisting of ten items developed to assess self-esteem on a 4-point rating scale, ranging from "strongly agree" to "strongly disagree." The total score ranges from 10 to 40, higher scores indicate higher self-esteem. Cronbach's alpha for this scale was 0.87 in our sample.

Personality. A shortened Dutch version of the Temperament and Character Inventory (TCI-105[22]) was used to assess personality characteristics. The TCI-105 consists of 105 items with responses in a true/false answer format. The items are divided into four temperament subscales (Novelty Seeking, Harm Avoidance, Reward Dependence and Persistence) and three character subscales (Self-Directedness, Cooperativeness and Self-Transcendence). Data on the TCI-105 was present for a subsample of 229 patients. Internal consistency of the TCI-105 was acceptable to good (Cronbach's alpha was 0.72 for Reward Dependence, 0.75 for Persistence, 0.77 for Cooperativeness, 0.81 for Novelty Seeking, Harm Avoidance and Self-Directedness, and 0.87 for Self-Transcendence).

Statistical Analyses

LPAs were conducted to identify latent classes of patients with EDs based on "healthy" and "unhealthy" perfectionism and impulsivity. In the LPA, patients are assigned to classes on the basis of posterior probabilities. All indicator variables were treated as conditionally independent. Contrary to the default, the variances for the indicator variables were not constrained to be equal across the classes. Because impulsivity tends to decrease when people get older,[23] age was entered as a covariate into the LPA modeling. The Lo–Mendell–Rubin (LMR) Likelihood Ratio[24] test, the Bayesian Information Criterion (BIC[25]), the size-adjusted BIC[26] and the consistent Aikaike's Information Criterion (cAIC[27]) were used to

TABLE 2.   Fit statistics for LPA model fitting analyses

Model	Best Log Likelihood	Free Parameters	BIC	Adjusted BIC	cAIC	LMR (K and K-1 model)	Entropy
1 class	−7,704.30	10	15,476.00	15,444.24	15,447.86	-	-
2 class	−4,319.56	18	8,760.40	8,703.24	8,709.80	0.000	0.70
3 class	−4,161.04	28	8,510.75	8,421.83	8,432.03	0.014	0.72
4 class	**−4,103.68**	**38**	**8,463.40**	**8,342.73**	**8,356.57**	**0.008**	**0.73**
5 class	−4,063.76	48	8,450.95	8,298.52	8,316.01	0.41	0.69
4 class;	**−4,025.64**	**42**	**8,334.27**	**8,200.90**	**8,216.20**	**-**	**0.70**
correlated residuals HP and UP							

Best-fitting models are depicted in bold. BIC = Bayesan information criterion, cAIC = Consistent Aikaike's Information Criterion, LMR = Lo-Mendell Rubin test, HP = healthy perfectionism, UP = unhealthy perfectionism.

FIGURE 1.   LPA profiles final four class solution. _Z_ scores of the indicator variables per class are depicted. HI = healthy impulsivity, UI = unhealthy impulsivity, HP + UP = healthy and unhealthy perfectionism, HP = healthy perfectionism.
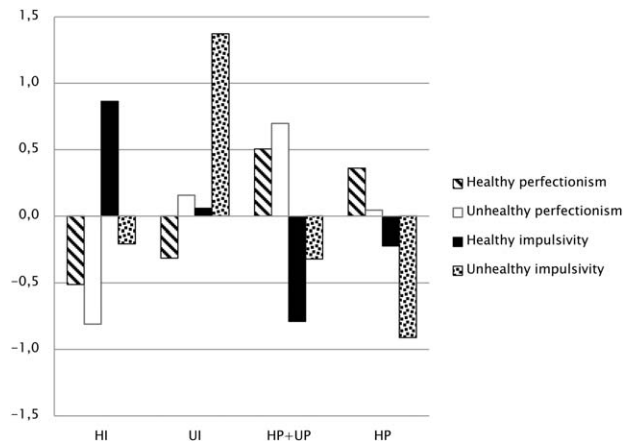
select the model that best represented the data. The LMR is a statistical test that compares the improvement in fit between neighboring class models (for example comparing a four to a three class model). A statistically significant result ($p < .05$) indicates that the higher class solution better represents the data. The BIC, adjusted BIC and cAIC provide measures of goodness of fit for comparing nested models; the lower the values the better the fit. In addition to the model fitting criteria, entropy was used to indicate how well the model could predict classes; the closer this r-squared value is to 1, the better. The LPA analyses were performed in Mplus version 7.3.[28]

In the validation analyses, the classes identified in the final LPA model were compared on a series of measures assessing ED psychopathology, comorbid psychopathology and personality features. A Pearson χ^2 test was used to compare the ED diagnoses between the classes. Depending on the distribution of the continuous measures, analysis of variance (ANOVA) followed by post-hoc (Games Howell) procedures or non-parametric tests (Kruskal–Wallis, post-hoc Mann–Whitney _U_) were performed to compare the LPA classes. Because of the large number of comparisons, sample size and exploratory

nature of these analyses, a conservative per comparison α-level of 0.001 was used to control for Type I error. Effect sizes were based on eta squared (η^2) for ANOVA and Kruskal–Wallis test and Cramer's _V_ for the Pearson χ^2 test. Because we wanted to perform both non-parametric and parametric tests, validation analyses were performed in SPSS version 22 instead of using the three-step procedure in Mplus. The three-step validation analyses are automatically weighed by the probability of the classes. To examine the effect of the probability of the classes on the results, a final series of weighted analyses were performed in SPSS.

Results

Demographics

The age of the patients ranged from 16 to 61 years, with a mean age of 27.9 years (SD = 9.4). Mean current BMI was 21.4 kg m^{-2} (SD = 7.4), and mean lifetime lowest BMI was 17.4 kg m^{-2} (SD = 4.4). In **Table 1**, the correlations, means and standard deviations of "healthy" and "unhealthy" perfectionism and impulsivity are presented.

Results of Latent Profile Analyses

A series of profile models were fitted starting from a single class solution and adding an additional class per step. The model fitting statistics can be found in **Table 2**. For the five class model the LMR test was nonsignificant for the first time, indicating that adding the fifth class did not improve the model fit. The BIC, adjusted BIC, and cAIC-values for the five class model were lower compared to the four class solution, however they decreased only by a relatively small amount. In addition, if the LMR incorrectly identifies a model, it tends to overestimate the number of classes.[29] Therefore the four class solution appeared to be the best-fitting model.

In the LPA, it was assumed that the indicator variables were conditionally independent. However, when we observed the residuals in the four classes,

TABLE 3.   Means, standard deviations and statistics for the validation analyses of the final profile solution

Measure	N	HI (n = 191)	UI (n = 238)	HP+UP (n = 153)	HP (n = 262)	Statistic	p values	Effect Size η^2	Contrast*
ED psychopathology									
BMI	844	22.4 (7.9)	23.9 (8.2)	19.5 (5.6)	19.4 (6.1)	H(3) = 64.7	<.001	0.08	(UI=HI)>(HP+UP=HP)
BMI_L	842	18.2 (4.9)	18.7 (4.6)	16.3 (3.5)	16.2 (3.6)	F(3,825) = 19.9	<.001	0.07	(UI=HI)>(HP+UP=HP)
EDE-Q Global score	829	3.8 (1.3)	4.3 (1.0)	4.6 (0.9)	4.0 (1.2)	H(3) = 50.1	<.001	0.06	(HP+UP=UI)>(HP=HI)
EDI-2 Drive for Thinness	219	34.8 (5.7)	36.4 (6.0)	37.5 (6.3)	35.2 (6.7)	H(3) = 10.9	<.05	0.05	HP+UP>HI
EDI-2 Bulimia	222	24.7 (10.4)	27.5 (10.5)	22.9 (9.9)	18.7 (9.7)	H(3) = 22.6	<.001	0.10	UI>HP
EDI-2 Body Dissatisfaction	223	41.9 (8.1)	44.7 (9.4)	47.2 (7.6)	42.5 (10.4)	H(3) = 10.7	<.05	0.05	HP+UP>HI
EDI-2 Perfectionism	224	21.4 (5.1)	21.4 (7.2)	25.8 (5.3)	23.0 (6.2)	H(3) = 22.6	<.001	0.08	HP+UP>(UI=HI)
EDI-2 Impulse Regulation	221	29.9 (7.6)	34.6 (7.4)	33.1 (6.3)	28.9 (6.9)	F(3,217) = 19.9	<.001	0.11	UI>HP
Comorbid psychopathology									
BDI	220	19.9 (8.9)	25.6 (11.0)	33.7 (8.8)	26.5 (11.2)	H(3) = 38.7	<.001	0.18	HP+UP>(HP=UI=HI)
Padua Inventory revised	209	32.4 (17.6)	45.7 (27.8)	59.0 (23.5)	49.6 (24.9)	H(3) = 29.0	<.001	0.14	HP+UP>(UI=HI); HP>HI
Self-Esteem	220	12.9 (5.2)	10.0 (5.1)	6.5 (4.2)	10.1 (6.0)	H(3) = 31.8	<.001	0.15	(HI=HP=UI)>HP+UP
Personality features (TCI-105)									
Novelty Seeking	213	6.5 (3.1)	8.5 (3.1)	3.5 (3.0)	3.1 (2.5)	H(3) = 83.9	<.001	0.39	(UI=HI)>(HP+UP=HP)
Harm Avoidance	216	9.3 (3.3)	11.1 (3.0)	12.5 (2.5)	11.8 (3.2)	H(3) = 26.4	<.001	0.12	(HP+UP=HP)>HI
Reward Dependence	213	8.9 (3.2)	9.1 (3.0)	7.9 (2.9)	8.9 (2.6)	H(3) = 5.1	ns		
Persistence	211	10.8 (2.9)	9.3 (3.3)	11.7 (2.4)	12.4 (2.1)	H(3) = 33.0	<.001	0.16	(HP=HP+UP)>UI
Self-Directedness	214	9.1 (3.5)	5.6 (3.6)	5.7 (3.3)	8.0 (3.5)	H(3) = 30.8	<.001	0.14	(HI=HP)>(HP+UP=UI)
Cooperativeness	216	12.9 (2.7)	12.1 (2.9)	13.6 (1.8)	14.1 (1.3)	H(3) = 23.8	<.001	0.11	(HP=HP+UP)>UI
Self-Transcendence	218	2.8 (3.4)	3.2 (3.7)	2.6 (3.4)	3.2 (3.3)	H(3) = 1.9	ns		

*Only contrasts significant at the α = 0.001 level are depicted. HI = "healthy impulsivity", UI = "unhealthy impulsivity," HP + UP = "healthy and unhealthy perfectionism", HP = "healthy perfectionism." EDE-Q = eating disorder examination questionnaire, EDI-2 = eating disorder inventory 2, BDI = beck depression inventory, TCI-105 = temperament and character inventory (shortened Dutch version). Effect size η^2: 0.02~small, 0.13~medium, 0.26~large.

the correlation between the "healthy" and "unhealthy" perfectionism residuals was substantial (modification indices > 22.7) in each class. To overcome this violation, a final model, with four classes allowing the residuals of "healthy" and "unhealthy" perfectionism to be correlated within each class, was tested. In this case, the BIC, adjusted BIC and cAIC-values could be used to compare the two models (four class model without and with correlated residuals). Adding the correlated residuals into the model improved the model fit substantially (BIC change from 8,463.40 to 8,334.27; adjusted BIC change from 8,342.73 to 8,200.90; cAIC change from 8,356.55 to 8,216.20). The entropy of the final model was 0.70.

In this final solution, four profiles could be identified (see **Fig. 1**). The first class "Healthy Impulsivity" consisted of 191 patients (22.6% of sample) who scored high on "healthy" impulsivity and low on "healthy" and "unhealthy" perfectionism. Patients who scored high on "unhealthy" impulsivity belonged to the "Unhealthy Impulsivity" class (n = 238, 28.2%). The third class, "Healthy and Unhealthy Perfectionism" was formed by 153 patients (18.1% of sample) who scored high on both forms of perfectionism and low on "healthy" impulsivity. Finally, the majority of the patients belonged to the "Healthy Perfectionism" class (n = 262, 31% of sample), indicating high scores for this indicator variable and low scores on "unhealthy" impulsivity.

Validation Analyses

Validation analyses were performed for the final four class model that included the correlated residuals between "healthy" and "unhealthy" perfectionism within each class. Means, standard deviations and comparison between classes for the three domains are presented in **Table 3**.

Eating Disorder Psychopathology. In **Figure 2** the frequencies of the DSM-IV ED diagnoses per class are presented. There were significant differences in the frequencies between the classes ($\chi^2(12) = 66.3$, $p < 0.001$, Cramer's V = 0.17). A relatively higher proportion of patients with restricting type AN belonged to the "Healthy Perfectionism" class (n = 91, 38.6% of class 4), compared to a lower proportion that belonged to the "Unhealthy Impulsivity" class (n = 26, 11.9% of class 2). This was in contrast to the patients with BN, the majority of these patients belonged to the "Unhealthy Impulsivity" class (n = 55, 25.2% of class 2) compared to a relatively small proportion that belonged to the "Healthy Perfectionism" class (n = 30, 12.7% of class 4). The majority of patients with BED belonged to the "Healthy Impulsivity" class (n = 22, 12.1% of class 1). There were no frequency differences between the classes in patients with AN of the binge-eating/purging type or in patients with EDNOS.

Both current and lifetime lowest BMI were significantly lower in the "Healthy and Unhealthy

FIGURE 2. DSM-IV eating disorder diagnoses per class for the final four-class solution. HI = healthy impulsivity, UI = unhealthy impulsivity, HP + UP = healthy and unhealthy perfectionism, HP = healthy perfectionism. ANR = anorexia nervosa restricting type, ANBP = anorexia nervosa binge-purging type, BN = bulimia nervosa, BED = binge-eating disorder, EDNOS = eating disorder not otherwise specified.
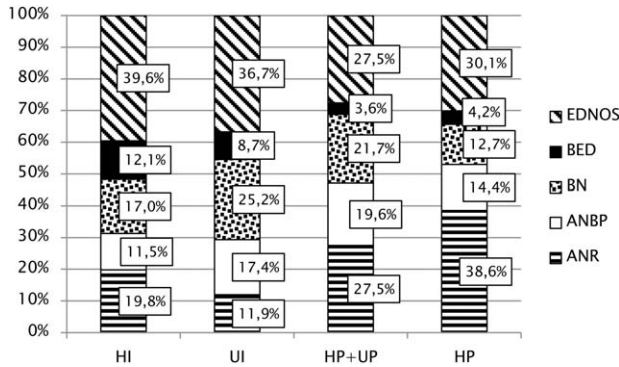
Perfectionism" and the "Healthy Perfectionism" class compared to the other two classes that were characterized by impulsivity. ED psychopathology, as measured by the global EDE-Q score, was significantly higher in the "Healthy and Unhealthy Perfectionism" and the "Unhealthy Impulsivity" class compared to the "Healthy Perfectionism" and "Healthy Impulsivity" class.

For the EDI-2 subscales the following differences emerged; patients belonging to the "Unhealthy Impulsivity" class scored significantly higher on the Bulimia subscale than patients belonging to the "Healthy Perfectionism" class. As expected patients belonging to the "Healthy and Unhealthy Perfectionism" class scored significantly higher on the Perfectionism subscale compared to patients belonging to the classes characterized by impulsivity ("Healthy Impulsivity" and "Unhealthy Impulsivity"). Furthermore, patients from the "Unhealthy Impulsivity" class scored significantly higher on the Impulse Regulation subscale than patients from the "Healthy Perfectionism" class. The overall differences in EDI-2 Drive for Thinness and Body Dissatisfaction, did not reach the conservative significance level of 0.001, but there was a trend that patients belonging to the "Healthy and Unhealthy Perfectionism" class tended to score higher than patients belonging to the "Healthy Impulsivity" class.

Comorbid Psychopathology. Depression and obsessive/compulsive symptoms were most endorsed by patients who belonged to the "Healthy and Unhealthy Perfectionism" class, whereas the scores on self-esteem were lowest in these patients. Scores on obsessive/compulsive symptoms were also high

for patients from the "Healthy Perfectionism" class.

Personality Features. As expected, novelty seeking was significantly higher in patients who belonged to the classes characterized by impulsivity ("Healthy Impulsivity" and "Unhealthy Impulsivity"). Patients belonging to the "Healthy and Unhealthy Perfectionism" or "Healthy Perfectionism" class scored higher on Harm Avoidance compared to patients who belonged to the "Healthy Impulsivity" class. Scores on Persistence and Cooperativeness were significantly higher in patients from the "Healthy and Unhealthy Perfectionism" and "Healthy Perfectionism" classes compared to patients from the "Unhealthy Impulsivity" class. Self-Directedness was higher in patients who belonged to the healthy classes ("Healthy Impulsivity" and "Healthy Perfectionism") compared to the unhealthy classes ("Healthy and Unhealthy Perfectionism" and "Unhealthy Impulsivity"). No differences in Reward Dependence and Self-Transcendence were found between the classes.

When weighting the validation analyses based on the probability of the identified classes, the majority of the results remained the same. The Kruskal–Wallis test for EDI-2 Perfectionism did not meet the conservative significance level of 0.001 anymore ($F(3,180) = 5.1$, $P = 0.002$, $\eta^2 = 0.08$). According to these same stringent criteria, the contrast between the "Healthy and Unhealthy Perfectionism" class and the "Unhealthy Impulsivity" class was no longer significant ($U = 974$, $z = -2.62$, $P = 0.009$) for the obsessive compulsive symptoms.

Discussion

In this study, latent profile analyses were performed to identify clusters of patients with EDs based on naturally occurring "healthy" and "unhealthy" perfectionism and impulsivity, and to investigate the association between this interplay and ED psychopathology, comborbid psychopathology and personality features. Four classes were identified in the best-fitting model: "Healthy Impulsivity," "Unhealthy Impulsivity," "Healthy and Unhealthy Perfectionism," and "Healthy Perfectionism." Patients belonging to the "Healthy and Unhealthy Perfectionism" class reported higher levels of ED, depression and obsessive-compulsive psychopathology and a lower level of self-esteem. Furthermore, these patients had high scores for the personality features Harm Avoidance, Persistence and Cooperativeness. The "Unhealthy Impulsivity" class was characterized by a high level of ED psychopathology and a high score of

Novelty Seeking. Patients belonging to the 'healthy' classes ("Healthy Impulsivity" and "Healthy Perfectionism") reported high levels of Self-Directedness. In addition, patients from the "Healthy Impulsivity" class had a high level of Novelty Seeking, whereas patients from the "Healthy Perfectionism" class had a high score for Harm Avoidance, Persistence and Cooperativeness.

In a recent cluster analysis on "healthy" perfectionism, "unhealthy" perfectionism and impulsivity in a group of community adolescents, four classes were identified but in none of these classes a distinction between "healthy" and "unhealthy" perfectionism was found.[14] This could be explained by the difference in sample, healthy adolescents versus patients with EDs. However, in our initial four class model solution "healthy" and "unhealthy" perfectionism also only co-occurred, but this changed when we allowed for correlated residuals between both forms of perfectionism within each class to fulfill the assumption of conditional independence. In addition, Boone et al.[14] identified a combined perfectionism and impulsivity cluster which had the highest level of ED psychopathology. In our study a combined perfectionism and impulsivity could not be found. Patients belonging to the "Unhealthy Impulsivity" class did have a slightly elevated score on "unhealthy" perfectionism, and also reported a high level of ED psychopathology. But the pure perfectionism class in our study ("Healthy and Unhealthy Perfectionism") was associated with the most severe comorbid symptoms in addition to a high level of ED psychopathology.

The majority of cluster- or latent class and profile analyses in EDs quite consistently retrieve three classes, namely "overcontrolled," "undercontrolled," and "low psychopathology."[30,31] The "overcontrolled" class is characterized by high compulsivity, rigidity, inhibition, and avoidance. The "undercontrolled" class is characterized by high impulsivity, emotional dysregulation, or activity and risky or dissocial behaviors. Because perfectionism may be construed as a form of compulsivity, this finding in line with our results; the "Healthy and Unhealthy Perfectionism" class from our analyses appears to be equivalent to the 'overcontrolled' cluster, the "Unhealthy Impulsivity" class equals the 'undercontrolled' cluster, and the two "healthy" classes ("Healthy Impulsivity" and "Healthy Perfectionism") are comparable to the "low psychopathology" cluster. Similar to our validation analyses, Lavender et al.[31] found the highest level of ED psychopathology in both the "undercontrolled" and "overcontrolled" clusters, and a lifetime diagnosis of Obsessive Compulsive disor-

der was particularly high in the "overcontrolled" cluster. On the other hand, higher rates of lifetime mood and anxiety disorders were found for both "undercontrolled" and "overcontrolled" clusters, while we found the highest level of depression symptoms in the "Healthy and Unhealthy Perfectionism" class.

The current study has several limitations. First, data on comorbid psychopathology and personality was only available for a selected subsample, consisting of patients with AN or BN. The results of the validation analyses on the comorbid and personality characteristics therefore might not be generalized to the complete ED sample. However, there is accumulating evidence that clinical severity, levels of self-esteem and rates of comorbid disorders (like depression and obsessive compulsive disorder) are comparable between the ED subtypes.[32–35] A recent meta-analysis on temperament in EDs,[36] showed that Harm Avoidance was higher in all ED categories compared to controls. In addition, patients with EDNOS showed a higher Persistence in comparison to controls, alike patients with AN or BN. On the basis of these findings we expect to find comparable results if the validation analyses were performed on data of the complete sample. Second, the ED types in our mixed ED sample were not distributed evenly, the majority of the patients had AN, which may have influenced our results. A mixed ED sample with a different composition, for example more patients with BED, may yield different profiles based on perfectionism and impulsivity. Third, our sample consisted of female patients only, affecting the generalizability of the results. Finally, the latent profile and validation analyses were performed with cross-sectional data. Therefore, it is not possible to determine the chronological sequence of the various traits and characteristics (e.g., did the "healthy" or "unhealthy" perfectionism precede the onset of the ED or depressive symptoms?), the stability of the identified classes (e.g., is there a large rate of cross-over between the classes in time?), or the effect of treatment on the classes (e.g., do the classes respond differently on treatment or do they have a different prognosis?). A longitudinal study in which patients with EDs are assessed at different time points could address several of these remaining questions.

Clinically relevant subgroups could be identified based on "healthy" and "unhealthy" perfectionism and impulsivity. Investigating personality features, like perfectionism and impulsivity, besides or in combination with diagnostic categories, yields essential information for both treatment and research. For example, despite the fact that patients with restricting type AN tend to be less impulsive,[5] 38

from the 191 patients with restricting type AN (19.9%) from our study belonged to the "Unhealthy Impulsivity" class. Because impulsivity is mainly associated with binge-eating and purging behavior in EDs,[5,37] this subgroup of patients with restricting type AN, may be the ones who cross-over to binge-purging type AN or BN in a later stage. 'Unhealthy' or Dysfunctional Impulsivity has, on the other hand, also been associated to the tendency to ignore hard facts before making a decision,[13] the indifference to reward or punishment[38] and depression and suicide ideation.[39] Characteristics that are not uncommon in restricting type AN. Because impulsivity is associated with poor prognosis in EDs,[6,7] it is important to identify patients characterized by impulsivity in time and address this personality feature in treatment. Furthermore, implementation of dimensional features, like perfectionism and impulsivity, in ED research, may enable the identification of fundamental underlying mechanisms and provide more insight into potential mechanisms that may drive or maintain disordered eating.[30]

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