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TOWARDS DIMENSIONAL CLASSIFICATION OF PSYCHOPATHOLOGY: A LATENT
PROFILE ANALYSIS OF PERSONALITY TRAITS

Master's thesis

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Towards dimensional classification of psychopathology: a latent profile analysis of
personality traits

Abstract

Personality-based profiling can help elucidate associations between pathological
symptomatology and address shortcomings of current diagnostic systems. Furthering these
aims, this thesis investigated personality-based profiles within a female sample that included
both patients ($n = 313$) and healthy controls ($n = 114$). It was hypothesised based on eating
disorder (ED) and transdiagnostic studies that 3–5 classes resembling high functioning,
undercontrolled and overcontrolled profiles would emerge. Anxiety, stress susceptibility,
mistrust, detachment, irritability and embitterment were expected to, in addition to
impulsivity and perfectionism, distinguish between profiles. Using latent profile analysis, a 5-
class solution proved best-fitting and the extracted profiles included a high-functioning, a
well-adapted, a moderately impulsive and socially dysregulated, an anxious-perfectionistic,
and an emotionally and behaviourally dysregulated class. Statistically significant differences
in depression, state anxiety and disturbed eating occurred, and diagnostic distribution across
classes was also meaningful with a large number of *bulimia nervosa* patients falling in the
impulsive and socially dysregulated class and the anxious-perfectionistic class displaying
depression and generalised anxiety. The emotionally and behaviourally dysregulated class
exhibited the most comorbidity and severe psychopathology. This hints at profiles' clinical
relevance in predicting current symptomatology. Due to over-representation of EDs in the
sample, future studies are warranted to replicate the found profiles. Additionally, longitudinal
studies are needed to assess treatment outcome and classification stability.

Keywords: personality-based profiling, LPA, latent profile analysis, impulsivity,
perfectionism, clinical sample, eating disorders

Dimensionaalse psühhopatoloogia käsitluse suunas: isiksusepõhine latentse profiili analüüs

Kokkuvõte

Isiksusepõhine profileerimine võimaldab kirjeldada patoloogiliste sümptomite omavahelisi seoseid ning ületada diagnostiliste süsteemide kitsaskohti. Neid eesmärke silmas pidades uuriti magistritöös isiksusepõhiseid profiile naiste valimil, kuhu old kaasatud nii patsiendid ($n = 313$) kui ka terved kontrollisikud ($n = 114$). Söömishäirete (SH) ja transdiagnostiliste uuringute põhjal püstitati hüpotees, et välja joonistuvad 3–5 klassi, mis sarnanevad hästi funktsioneerivale, alakontrollitud ja ülekontrollitud klassidele, ning et klasse eristavad impulsiivsuse ja perfektsionismi kõrval ärevus, stressitundlikkus, umbusaldus, eraldaumine, ärrituvus ja kibestumus. Latentse profiili analüüsi põhjal sobis andmestruktuuriga kõige paremini viieklassiline lahend, tuvastati järgmised klassid: hästi funktsioneeriv, hästi kohanev, mõõdukalt impulsiivne ja sotsiaalselt düsreguleeritud, ärev-perfektsionistlik ja emotsionaalselt ja käitumuslikult düsreguleeritud klass. Depressiooni, seisundiärevuse ja häirunud söömise puhul leiti klasside lõikes statistiliselt olulised erinevused ning diagnostiline jaotus võimaldas samuti profiile kirjeldada. Suur osa *bulimia nervosa* patsiente kuulus impulsiivsesse ja sotsiaalselt düsreguleeritud klassi ning märkimisväärsel osal ärevast-perfektsionistlikust klassist oli depressioon või üldistunud ärevushäire. Kõige rohkem komorbiidseid häireid ning psühhopatoloogiat esines emotsionaalselt ja käitumuslikult düsreguleeritud klassil. Tulemused viitavad profiilide kliinilisele olulisusele käesoleva sümptomaatika ennustamisel. SH üleesindatuse tõttu valimis peaks tulevikus leitud profiile replikeerima. Lisaks on klassifitseerimisotsuse ajalise stabiilsuse ja ravivastuse hindamiseks vaja läbi viia longituudseid uuringuid.

Märksõnad: isiksusepõhine profileerimine, LPA, latentse profiili analüüs, impulsiivsus, perfektsionism, kliiniline valim, söömishäired

With every revision of the International Classification of Diseases (ICD) and the Diagnostic and Statistical Manual of Mental Disorders (DSM), classification systems are updated to better fit empirical evidence and needs of practitioners. The latest versions of the ICD and DSM have partly succumbed to pressures from the academic community, introducing hybrid conceptualisations, e.g. for personality disorders (Cuthbert, 2014; American Psychiatric Association [APA], 2013; World Health Organisation [WHO], 2018). Regardless, the scope of such amendments is limited, thus retaining the prevailing perception of disorders as discrete entities.

This thesis aims to highlight the problems of current classification systems, focusing on assessing joint personality-based core disturbances. Based on proposals of empirically validated alternative nosologies, a person-centred clustering technique is introduced. With this approach, *a priori* class borders are rejected and a bottom-up personality-based approach is suggested to account for the varied phenomenology and clinical presentation of disorders and, as such, provide preliminary implications for treatment.

Limitations of existing classification systems

The ICD (WHO, 1992) and DSM (APA, 2013) disorder classifications have largely become synonymous with general understanding of the conceptual core of such functional impairments (Dalgleish et al., 2020). Although reliance on common ground eases communication, this brief literature review introduces four shortcomings of current systems to set up the thesis – widespread comorbidity, within-disorder heterogeneity, insufficient attention to sub-threshold symptoms and common biopsychosocial basis.

Firstly, differentiation between primary and secondary diagnoses is often difficult, with some authors suggesting that sole presentation of a single disorder is rare in clinical practice (Krueger & Markon, 2006). Co-occurrence widely applies within and across existing disorders, for example, among mood, anxiety and personality disorders, eating disorders (EDs) and substance use disorders (SUDs) (e.g. Bahji et al., 2019; Lai et al., 2015; Lamers et al., 2011). Homogeneity across disorders is also illustrated by diagnostic fluidity. Longitudinal assessment of symptom trajectories reveals that individuals with anxiety, mood disorders or EDs can cross diagnostic borders and within-class plasticity is widely common (e.g. Steinert et al., 2014; Fichter et al., 2010; Stice et al., 2013).

Secondly, within-diagnosis heterogeneity complicates conceptualisation and treatment – including subsymptoms and directional qualifiers, one diagnosis can accommodate thousands of symptom presentations (Fried & Nesse, 2015). Varied pathological presentations

that affect treatment response have been noted, for example, in depression (Fried & Nesse, 2015), EDs (Sysko et al., 2010) and anxiety disorders (Beesdo et al., 2010).

Thirdly, since the DSM and ICD require binary assessments of diagnostic criteria, dimensional symptom profiles are moulded into categorical disorders, creating a mismatch between the diagnostic label and the nature of the phenomena intended to be captured, exemplified by the wide occurrence of sub-threshold impairments and "not otherwise specified" (NOS) disorders (Regier et al., 2013). Classifying such individuals as healthy or under a NOS-category not only fails to account for symptom profiles slightly deviant from the ones prescribed by the current *lingua franca* manuals, but can also hinder further treatment (e.g. Haller et al., 2014; Fairweather-Schmidt & Wade, 2014).

Finally, following a biopsychosocial approach to conceptualising vulnerability, resilience and disorder maintenance, overlap in mechanisms has been postulated. There is transdiagnostic evidence for the serotonergic and dopaminergic systems influencing mood, motivation, reward sensitivity and aggression (Nordquist & Oreland, 2006; Ayano, 2016). Turning to examples of psychological and social risk factors, it has been repeatedly shown that childhood maltreatment and parental mental disorders increase the risk for mental disorders (McCrory & Viding, 2015; Dean et al., 2010).

Thus, accumulating evidence points to traditional diagnoses having insufficient validity and clinical utility, since categorisation without accounting for underlying shared variability and dimensionality can be arbitrary (Chmielewski et al., 2015). In practice, this is illustrated comorbidity-hindered treatments and difficulties in developing new interventions, since randomised control trials groups must be homogenous, yet there is an abundance of symptom configurations and rampant disorder co-occurrence (Hopwood et al., 2020).

Alternative proposals for classification

Based on the previously outlined shortcomings, several new classification schemes have been developed. In what follows, personality-based approaches will be focused on, since personality traits are relatively stable in time, vary dimensionally in the general population and are candidates for endophenotypes informing pharmacological intervention (Miller & Rockstroh, 2013; Vukasović & Bratko, 2015).

Personality traits as transdiagnostic determinants of psychopathology

Although different personality traits have been hypothesized to underlie common variance in presentations of psychopathology, four such features have prominently arisen as

candidates contributing to a general psychopathology factor p: negative affectivity, poor impulse control, perfectionism and interpersonal personality pathology (Caspi et al., 2014).

Negative affectivity is conceptualised as a disposition towards experiencing negative emotions which can manifest in frustration, fear and anxiety (e.g. Gray, 1978). A meta-analysis has shown negative affectivity to be characteristic to depression, anxiety and SUD patients (Kotov et al., 2010). Since negative affectivity is a complex construct, its association with pathology is non-linear; e.g. anxiety sensitivity is a mediator in fear-related disorders (e.g. panic disorder and specific phobias) and intolerance of uncertainty in distress-related disorders (e.g. depression, generalised anxiety disorder (GAD) and post-traumatic stress disorder (PTSD); Paulus et al., 2015). This hints at the need to firstly analyse associations at symptom-, not diagnosis-level, and secondly to incorporate more personality traits, such as stress susceptibility, to adequately reflect pathological personality profiles.

Impulsivity is a multidimensional trait evident in poorly planned behaviour, sensitivity to reward and deficient executive control (Robbins et al., 2012; Dalley et al., 2011). Behavioural impulsivity has been related to suicidality, anger, hostility, aggression; while cognitive dimensions, such as lack of executive control contribute to the etiology of mood and anxiety disorders, SUDs and EDs (Johnson et al., 2013; Santens et al., 2020). The tendency to take rash action upon feeling negative emotions has been implicated as a treatment target for both behavioural addictions and SUDs (Kim & Hodgins, 2018). This finding sheds light on potential association with negative affectivity that disposes individuals to feel negative emotions.

Clinical perfectionism reflects pursuance of unreasonably high standards, regardless of their potentially harmful outcomes (Fairburn et al., 2003). Perfectionism is a multidimensional concept that can encompass both self-oriented goals and expectations of others (Frost et al., 1990). Evidence demonstrating transdiagnostic perfectionism is apparent in elevated levels of the trait in a wide array of mental disorders, including EDs, obsessive-compulsive disorder (OCD), social anxiety, GAD, PTSD and panic disorder (Egan et al, 2011). More explicitly, perfectionism is associated with higher comorbidity rates (Bieling et al., 2004). Transdiagnostic treatment protocols targeting perfectionism have shown promising results in reducing general psychopathology (Egan et al., 2011).

Finally, in addition to self-emotional transdiagnostic factors, personality traits reflecting interpersonal communication deficits have been implicated as meaningful determinants of clinical phenotypes (Hartmann et al., 2010; Petty et al., 2004). Facets of interpersonal aggression and detachment predict depression and anxiety symptomatology as

well as lower quality of life (McEvoy et al., 2013). Special attention has been paid to trait irritability, which has proven to be a vulnerability factor in both SUDs and mood disorders (Koob & Volkow, 2010; Carlson & Klein, 2014; Judd et al., 2013). However, such traits have sometimes been classified under negative affectivity or been merged with behavioural manifestations of impulsivity, making impact assessment difficult.

Person-centred clustering for profiling mood, anxiety and eating disorders

Simply recognising transdiagnostic influences is insufficient for contributing to treatment of disorders, giving rise to personality-based profiling (Nolen-Hoeksma & Watkins, 2011). Bohane et al.'s (2017) systematic review of personality profiles revealed most clinical clustering studies to have focused on individuals with EDs and postulated the scarcity of personality-based classification in populations with primary diagnoses of anxiety and mood disorders. Attempting to provide explanations for diagnostic migration and heterogeneity, studies on ED categorisation have often converged on a 3-class solution with undercontrolled, overcontrolled and resilient profiles (Wildes & Marcus, 2013). The undercontrolled class is emotionally labile and behaviourally disinhibited, the overcontrolled disposed to avoidance, emotional restriction, rigid perfectionism and anxiousness, while the resilient class is high functioning and demonstrates moderate levels of perfectionism and conscientiousness (e.g. Westen & Harnden-Fischer, 2001). Soidla and Akkermann (2020) recently showed emergence of three undercontrolled classes on a mixed sample of controls and ED patients, expanding on the necessity to differentiate between emotional and behavioural manifestations and suggesting inclusion of additional measures is merited.

Attempting to expand findings from ED samples to other populations, Christian and colleagues (2021) demonstrated on a large population-based sample that four profiles can be extracted based on impulsivity and perfectionism: classes of high perfectionism (associated with compulsivity, worry, social anxiety, depressive mood, restricting and bingeing), high impulsivity (pronounced alcohol use), high perfectionism and impulsivity (both internalising and externalising psychopathology), and low perfectionism and impulsivity emerged (the least disturbances), resembling, for example, results Boone et al.'s (2014) study on an ED sample.

Although similar profiles describing levels of compulsive control and impulsivity have sometimes been shown to emerge in individuals with anxiety and mood disorders, evidence is mixed (Spinhoven et al., 2012; Ulbricht et al., 2019). Note-worthy transdiagnostic classification studies include Brown and Barlow's (2009) who profiled patients' depressive and manic mood, autonomic activation, intrusive cognitions, social well-being, avoidance and

trauma. Rossellini and Brown (2014) used a person-centred clustering on an outpatient sample (social phobia, GAD, depression, panic disorder, specific phobia, OCD) to assess Brown and Barlow's (2009) model. They obtained a six-class solution: two classes with limited impairment (negligible-mild and mildly-neurotic), and a panic-somatic (elevated autonomic arousal and somatic anxiety), a social-depressed (depressive mood and anxiety in social situations), an obsessed-worried (intrusive thoughts) and a severe-comorbid class, with heightened impairment on all measures (Rossellini & Brown, 2014).

Limited literature is available on personality-based profiling on mixed samples with EDs and other psychopathological presentations included, yet joint transdiagnostic basis offers preliminary justification for combined analysis (Bullis et al., 2018). Compensating for the underexplored niche of general psychiatric populations, the Hierarchical Taxonomy of Psychopathology (HiTOP) synthesised analyses of combined data sets of thousands of subjects and postulated an internalising spectrum which comprised mood and anxiety disorders, and EDs (with the exception of mania; Kotov et al., 2017; Dalgleish et al., 2020). Individuals with syndromes on the internalising spectrum share dysfunctional personality traits, such as anxiousness, hostility and emotional lability, which can be interpreted as facets of negative affectivity and irritability (DeYoung et al., 2020; Kotov et al., 2017).

Although HiTOP's hierarchical structure helps account for divergent results in clustering and structural equation modelling studies, it can criticised for failing to elucidate co-occurrence of SUDs (identified as a distinct subfactor of the externalising spectra) and mood, anxiety disorders and EDs (Blanco et al., 2015). Most importantly in the context of generalising from ED studies to the general psychiatric population, HiTOP fails to recognise the variance of both impulsivity and perfectionism within the internalising spectrum – urgency and low behavioural control are listed as traits of the externalising spectra (Kotov et al., 2017). As such, the HiTOP can lack explanatory power and its *prima facie* clinical utility needs empirical proof, since authors like Reed (2018) have found its usability in informing treatment selection limited.

Current study

Review of previous research reveals several shortcomings. Firstly, many studies fail to find a balance between exploratory and confirmatory approaches. While hypotheses-free studies hinder progressing the discourse by refraining from comparing nosologies and assessing the fit of existing approaches on new samples; confirmatory studies suffer from overfitting the 3-class overcontrolled, undercontrolled and resilient model (Wiecki et al.,

2015; Bohane et al., 2017). Secondly, research is often carried out within specific diagnostic classes, among which EDs have arguably received most attention – indirectly affirming categorisation into current disorder classes. As such, empirically proven joint transdiagnostic basis of mood and anxiety disorders, SUDs and EDs is not addressed. On the flipside – nosologies addressing the entire spectrum of mental disorders such as HiTOP, offer intuitively appealing alternatives less dependent on the validity of antecedent classifications, however, connections between extracted clusters remain unclear and phenomenological richness is lost (Jablensky, 2018).

This study addresses such gaps in literature by using a person-centred clustering technique to describe the profiles of individuals within a clinical sample, using evidence from studies on ED patients to drive preliminary hypotheses. Firstly, the thesis brings together results from transdiagnostic investigations, with previous research informing measure selection beyond impulsivity and perfectionism to avoid overfitting. The thesis also expands on research by Rossellini and Brown (2014) in which ED patients were not sampled and where the trait-symptom distinction became arguably muddled. Secondly, the thesis aims to address the extent to which latent structure of symptomatology reflects a joint core impairment, without giving *a priori* priority to disorder class membership, thus indirectly assessing the applicability of HiTOP. In addition to theory-building, pursuing this area of research holds great potential in terms of clinical utility: movement towards a dimensional approach to psychopathology would allow practitioners to align diagnosis and conceptualisation, since co-occurring symptoms would be more meaningful (Hopwood et al., 2020).

Using latent profile analysis, the following hypotheses will be tested:
H1: 3–5 profiles that resemble the overcontrolled, undercontrolled and low psychopathology classes will be distinguishable in individuals with ED, mood and anxiety disorders;
H2: in addition to impulsivity and perfectionism, somatic and psychic anxiety, stress susceptibility, mistrust, embitterment, irritability and detachment meaningfully contribute to profile differentiation;
H3: class membership differentially determines variation in emotional state measures analysed as outcome variables.

The author's original contribution entails conceptualisation, development of data analytic plan, all data analyses and their interpretation, and writing the manuscript.

Method

Participants

The sample comprised 427 women (total sample), out of whom 249 (58.3%) had been diagnosed with an eating disorder (ED sample), 64 had a primary diagnosis of mood and anxiety disorders or SUDs (15%; mood and anxiety disorder (MOOD-ANX) sample) and 114 (26.7%) were healthy controls (control sample). Table 1 lists prevalence of disorders in clinical sample. Exclusion criteria for controls included current but not lifespan diagnoses of mental disorders. The ED, MOOD-ANX and control sample were demographically comparable, although ED patients were younger than other participants (ED $M = 21.91$, $SD = 6.77$; MOOD-ANX $M = 23.89$, $SD = 7.03$, control $M = 23.99$, $SD = 7.78$; ED compared to MOOD-ANX participants $U = 5,854.5$, $p = .004$, compared to controls $U = 1,0995.5$, $p = .006$). There were no significant differences in education between the groups ($\chi^2(8, N = 419) = 6.83$, $p = .56$). Patients were recruited in an inpatient setting at the Psychiatric Clinic of the Tartu University Hospital, the control sample via university mailing lists and public calls.

Measures

Three sets of measures were included: 1) indicator variable measures of the latent profile analysis, 2) alternative validation measures; 3) external validation measures for assessing the profiles' association with emotional state.

Indicator variable measures

Personality. Personality was profiled with the Swedish Universities Scales of Personality (SSP; Gustavsson et al., 2000; in Estonian Aluoja et al., 2009). The SSP is designed to establish the neurobiological correlates of pathological personality. The SSP is a 91-item self-report questionnaire, comprising 13 scales, seven items each (Estonian: α = .58–.85 scale level). Items are assessed on a 4-point scale. Composite scores of seven SSP scales were utilised as indicator variables: somatic and psychic trait anxiety, stress susceptibility, detachment, embitterment, trait irritability and mistrust. Psychic and somatic anxiety and stress susceptibility have been shown to load onto a general negative affectivity factor, but while the two first scales reflect general proneness to anxiety, somatic anxiety is comparable to autonomic arousal in Rossellini & Brown (2014; Gustavsson et al., 2000; Aluoja et al., 2009). Trait irritability and embitterment reflect dysphoric mood and encapsulate facets of anxiety and aggression, while detachment encompasses withdrawal from social interactions and is significantly correlated with mistrust (Gustavsson et al., 2000, Aluoja et al., 2009). Aluoja et al. (2009) have shown detachment and mistrust to be significantly negatively

correlated with extraversion on the Big Five personality scales, lending support to the theory that higher scores on mistrust and detachment could reflect a transdiagnostic vulnerability factor.

Impulsivity. Impulsivity was assessed with Dickman's Impulsivity Inventory (DII; Dickman, 1990; in Estonian Kuppart, 2005). DII measures dysfunctional (DFI) and functional impulsivity (FI), the first reflecting difficulties arising from rash action and the second the merits of acting with little forethought (original: α = .74–.85 scale level). The Estonian DII is a 24-item (12 to tap functional and 12 to assess dysfunctional impulsivity) self-report questionnaire in which items are rated on 5-point scale. In this study, the DII's scales' total scores were included as indicator variables.

Perfectionism. Perfectionism was assessed with the Multidimensional Perfectionism Scale (MPS; Frost et al., 1990; in Estonian Saarniit, 2000). The original MPS is a 35-item self-report questionnaire, the Estonian version has 28 items, making up four scales: concern over mistakes, parental standards and expectations, personal standards and organisation (Estonian: α = .81–.86 scale level). Items are rated on a 5-point scale. Two composite EMPS scale scores – positive (personal standards and organisation) and negative perfectionism (concern over mistakes and parental standards) – were included as indicator variables

Alternative measure variable measures

Personality and perfectionism. As a parallel measure to SSP and MPS, the International Personality Item Pool NEO was used (EPIP-NEO, Goldberg, 1999, in Estonian Mõttus et al., 2006). The 240-item self-report instrument assesses 30 different personality facets, and reflects five higher-order factors: neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness (Estonian: α = .89–95 factor level).

Trait anxiety. As a parallel measure to somatic and psychic anxiety and stress susceptibility, the State-Trait Anxiety Inventory was used (STAI; Spielberger, 1983; in Estonian Kreegipuu, 1997). The STAI is a two-factor 40-item self-report questionnaire that distinguishes between state anxiety experienced by the test-taker at that moment in time, and a more general proneness to anxiety (original scale α = .90–.92). Items are scored on a 4-point scale.

Impulsivity. As a parallel measure to DII, the Barratt Impulsivity Scales total score was used (BIS-11; Patton et al., 1995; in Estonian Paaver et al., 2007). The Estonian BIS-11 is a 31-item self-report scale that has a six-factor primary level factor structure and a three-factor second order structure (total α = .80). Items are rated on a 4-point scale.

External validation variable measures

      General psychopathology. To characterise the derived profiles by diagnostic categories, the Mini International Neuropsychiatric Interview was used (M.I.N.I; Sheehan et al., 1998; in Estonian Shlik et al., 1999). The M.I.N.I is a brief structured clinician-administered interview. Test-retest reliability of the original instrument varies (.52–1.00) across scales, interrater reliability ranges between .89–1.00.

      Emotion regulation difficulties. Emotion regulation was assessed with the total scores of the Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004; in Estonian Vachtel, 2011). The DERS reflects six factors: nonacceptance of emotional responses, difficulties engaging in goal-directed behaviours, impulse control difficulties, lack of emotional awareness, limited access to emotion regulation strategies, and lack of emotional clarity (original total $\alpha = .93$). The Estonian DERS has 34 items rated on a 5-point scale.

      Depression. Depression was evaluated with the self-report Montgomery-Åsberg Depression Rating Scale (MADRS; Svanborg & Åsberg, 1994). The MADRS is a 9-item measure, items are endorsed on a 7-point scale (original $\alpha = .83$; Fantino & Moore, 2009).

      State anxiety. State anxiety was assessed with the STAI state scale (Spielberger, 1983; in Estonian Kreegipuu, 1997).

      Disordered eating. Disordered eating behaviour was assessed with the Eating Disorder Assessment Scale, a self-report measure with 29 items (EDAS, Herik, 2009; Akkermann et al., 2010). Items are rated on a 6-point scale and form four subscales: dietary restraint, bingeing, purging, and preoccupation with weight and body image ($\alpha = .90–.93$).

Procedure

      For the inpatient sample, data was gathered at the Psychiatric Clinic of the Tartu University hospital, healthy controls filled in questionnaires in a university setting. Data was collected by trained clinical psychologists within research projects "Inhibitory control and emotional bias in eating disorders patients" and "Eating disorders and serotonin-related markers". Participants gave written informed consent. Study procedures were approved by the Research Ethics Committee of the University of Tartu.

Statistical analysis

      Profiles were extracted via latent profile analysis (LPA). LPA is a person-centred method for probability-based classification based on observed variation in continuous indicator variables, extracted classes reflect an unobservable latent structure (Muthén & Muthén, 1998–2017). LPA does not assume normality of distributions but requires

independence of observations accounted for in study design. Data was estimated under the robust maximum likelihood parameter. The full information maximum likelihood (FIML) method was applied to missing data in indicator variables to retain power and allow for comparisons between studies, while remaining relatively unbiased, as shown in simulation studies (Cham et al., 2017). Consistently missing data patterns were excluded from analysis; validation analyses used pairwise deletion to account for missing values.

Analyses were run with three sets of starting values to correct for converging on local maxima: random values, 100 initial and 20 final, and 1000 initial and 250 final stage optimisations, with final optimisations equal to or less than one quarter of initial values (Muthén & Muthén, 1998–2017). Only analyses with 1000 initial and 250 final stage optimisations are reported, differences are flagged. For bootstrapped samples, initial starts were increased to 200 and final optimisations to 40, troubleshooting for failed draws.

The best-fitting model was chosen based on parsimony, theoretical interpretability and goodness-of-fit indicators: logarithm of the likelihood of fit (LL), Bayesian Information Criterion (BIC), sample-adjusted BIC (SABIC) and Akaike's Information Criterion (AIC) (Tein et al., 2013; Ferguson et al., 2020). Lower absolute values of LL, BIC, SABIC and AIC indicate better fit. Since comparative analyses have found BIC to outperform other information criteria indices and BIC is the most suitable indicator for analysis with many indicators, it was considered the preferential measure in this study, however, it can underpredict in smaller samples (Nylund et al., 2007; Morgan, 2015). All indices were plotted to detect theoretically meaningful changes in values across models (Ferguson et al, 2020). Entropy was used to capture classification quality; values surpassing .80 indicate minimal uncertainty (Masyn, 2013). Finally, the adjusted Lo, Mendell and Rubin (LMR-LRT) and bootstrap likelihood ratio tests (BLRT) were used to assess extraction of k versus $k-1$ profiles to achieve optimal parsimony (Ferguson et al., 2020). Non-significant BLRT and LMR-LRT tests indicate a more representative model. Simulation studies have shown BLRT to never reach a non-significance, so this study primarily focuses on agreement of BLRT and LMR-LRT with BIC (Morgan, 2015; Masyn, 2013).

Four validation strategies were used to ensure identification of true classes (van Rentergem et al., 2021). Firstly, mean probabilities of items to belong to the identified classes was considered. Secondly, LPAs were run on two subsamples with equal proportions of the ED, MOOD-ANX and control sample. Although less reliable than replication on independent samples, the split-half method provided additional proof within the scope of this thesis. Thirdly, alternative measure validation was used by comparing means of instruments

designed to assess constructs resembling indicator variables. Finally, external validation established associations of classes with variables not utilised in the construction of subtypes.

Normality of distributions was assessed with kurtosis and skewness (–1-1), both parametric and non-parametric tests were reported in assumption violations to offer explanatory power. The Tukey *post-hoc* test was used for homogenous variances. Frequencies of categorical variables in classes were tested with Chi-squared tests and Bonferroni-corrected *post-hoc* tests. All LPA analyses were conducted in MPlus version 6.12 (Muthén & Muthén, 1998–2017). Validation analyses were performed in IBM SPSS version 26.00.

Results

Descriptive statistics

Among the combined ED and ANX-MOOD sample, 63.6% of participants had at least one comorbid diagnosis. The number of diagnoses ranged between 1 and 10 and averaged at $M(SD) = 1.86(2.07)$ per participant. Most prevalent diagnoses are presented in Table 1. Descriptive statistics across indicator and validation variables are presented in Appendix A.

Table 1

Prevalence of psychiatric disorders in the clinical sample

ICD-10 disorder	n	% of clinical sample ($n = 308$)
Eating disorders	249	80.8%
Anorexia nervosa (including atypical)	121	39.3%
Bulimia nervosa (including atypical)	107	34.5%
Binge eating disorder	17	5.5%
Mood disorders	162	52.6%
Depression, recurrent episodes, dysthymia	157	51.0%
Manic episodes and bipolar disorder	12	3.9%
Harmful use of alcohol, dependence	53	17.2%
Anxiety and stress-related disorders	149	48.4%
Agoraphobia	50	16.2%
Social phobia	64	20.8%
Panic disorder	29	9.4%
Generalised anxiety disorder	78	25.3%
Obsessive compulsive disorder	23	7.5%
Post-traumatic stress disorder	23	7.5%

Latent profile analysis

Model fit estimation

Summary model fit statistics for the total sample are reported in Table 2. Fit indices and corresponding model with total sample for all subsamples are reported in Appendix B to provide context for findings in the total sample, since independently, they lack statistical power to be considered reliable.

Total sample ($N = 420$) LPA iterative analyses provided mixed evidence for the 3- and 5-class solution. A high entropy of .87 served as evidence in favour of the 3-class solution, LMR-LRT indicated the model's superiority in comparison to the 2-class model. However, the 5-class model was supported by the best BIC value and better LL, AIC and SABIC values in comparison to the 3-class model. Since entropy values surpassing .80 are taken to reflect good fit, and the adjusted LMR-LRT can underpredict class number, the 5-class model garnered more support in total and was thus selected as the best model. To study reasons for divergent evidence, 3–5-class solutions are presented in the next section. Analyses were also run without controls, to assess whether their inclusion affects results ($n = 306$, Table 2). Mixed evidence for 3–5-class solutions was found, since LMR-LRT only reached significance for the 3-class model, yet the 4-class solution had the lowest BIC and the relatively large smallest class in the 5-class solution also hints at the existence of a true latent class. The 5-class solution is highlighted in the next section for comparison with total sample.

Table 2

Fit indices for 1–8 class LPA models in the total sample, controls included and excluded

No	LL	AIC	BIC	SABIC	Entropy	SMALL %	LMR (p)	BLRT (p)
Total sample								
1	−16,633.62	33,311.23	33,400.12	33,330.31	—	—	—	—
2	−16,062.65	32,193.29	32,330.66	32,222.77	.84	49.5%	.003	<.001
3	−15,830.15	31,752.30	31,938.15	31,792.18	.87	20.5%	<.001	<.001
4	−15,768.51	31,653.03	31,887.36	31,703.31	.81	13.8%	.47	<.001
5	**−15,724.51**	**31,589.03**	**31,871.85**	**31,649.71**	**.80**	**13.3%**	**.23**	**<.001**
6	−15,693.33	31,550.66	31,881.96	31,621.75	.81	5.2%	.46	<.001
7[a]	−15,664.56	31,517.11	31,896.89	31,598.60	.82	2.6%	.34	<.001
8[b]	−15,639.70	31,491.39	31,919.66	31,583.29	.80	2.4%	.69	<.001
Controls excluded								
1	−12,176.77	24,397.54	24,479.46	24,409.69	—	—	—	—
2	−11,843.89	23,755.77	23,882.38	23,774.54	.80	42.8%	.10	<.001
3	−11,680.11	23,452.22	23,623.50	23,477.61	.88	12.8%	<0.001	<.001
4	−11,633.31	23,382.63	23,598.60	23,414.65	.81	10.8%	.34	<.001
5	−11,602.77	23,345.54	23,606.19	23,384.18	.77	10.1%	.64	<.001
6[c]	−11,572.38	23,308.77	23,614.10	23,354.04	.81	2.9%	.31	<.001
7[d]	−11,545.70	23,279.39	23,629.41	23,331.28	.82	3.6%	.46	<.001
8	−11,519.82	23,251.64	23,646.34	23,310.15	.82	3.6%	.51	<.001

Note. Best-fitting model in bold. No = Number of classes in tested model; LL = log likelihood; AIC = Akaike's Information Criterion; BIC = Bayesian Information Criterion, SABIC = sample–adjusted Bayesian information criterion; SMALL % = proportion of sample in smallest class; LMR = adjusted Lo–Mendell–Rubin likelihood ratio test; BLRT = bootstrap likelihood ratio test.
[a] With random starts: LL = −15,667.89, AIC = 31,527.78, BIC = 31,907.57, SABIC = 31,609.28; smallest class 2.14% participants; LMR p = .73.
[b] With random starts LL = −15,641.35, AIC = 31,494.70, BIC = 31,922.97, SABIC = 31,586.60, smallest class 2.14% participants, LMR p = .45.
[c] With random starts, LMR p = .29.
[b] With random starts, LL = −11548.33, AIC = 23284.67, BIC = 23634.68, SABIC = 23336.56, smallest class 3.27% participants, LMR p = .51.

Profile characteristics

In the 3-class model (Figure 1), the following classes emerged: 1) a class characterised by low psychic and somatic anxiety, stress susceptibility, embitterment, detachment, irritability and mistrust, as well as low perfectionism and dysfunctional impulsivity and high functional impulsivity – the high functioning class; 2) a class with average scores on all indicator variables – the moderate class; 3) a class with very high somatic and trait anxiety, stress susceptibility, embitterment, mistrust and perfectionism; high dysfunctional impulsivity, irritability, and low functional impulsivity – the emotionally and behaviourally dysregulated class.
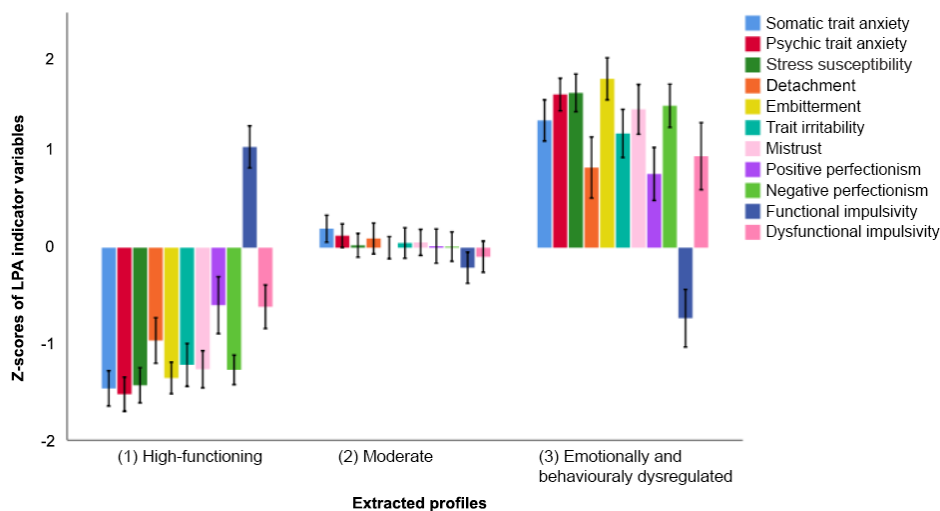
Figure 1

Z-scores with 95% confidence intervals in the 3-class total sample solution

In the 4-class model (Figure 2), the moderate class separated into two, leaving one moderate and one anxious-perfectionistic class, with highest scores on the somatic and psychic anxiety and stress susceptibility scales, pronounced negative perfectionism and elevated embitterment and irritability. With the extraction of an additional, fifth class (Figure 3), the moderate class developed into a well-adapted class ($n = 56$) only differing from the high-functioning ($n = 112$) class quantitatively. Furthermore, two separate profiles emerged from the anxious-perfectionistic class: a moderately impulsive and socially dysregulated class, characterised by elevated embitterment, irritability, mistrust and also somatic anxiety ($n = 114$), and an anxious-perfectionistic class ($n = 66$), characterised by low dysfunctional impulsivity and high perfectionism, psychic anxiety and stress susceptibility. The emotionally and behaviourally dysregulated class remained intact ($n = 72$). Across profiles, all tests of means comparisons of indicator variables were statistically significant, results in Table 3.
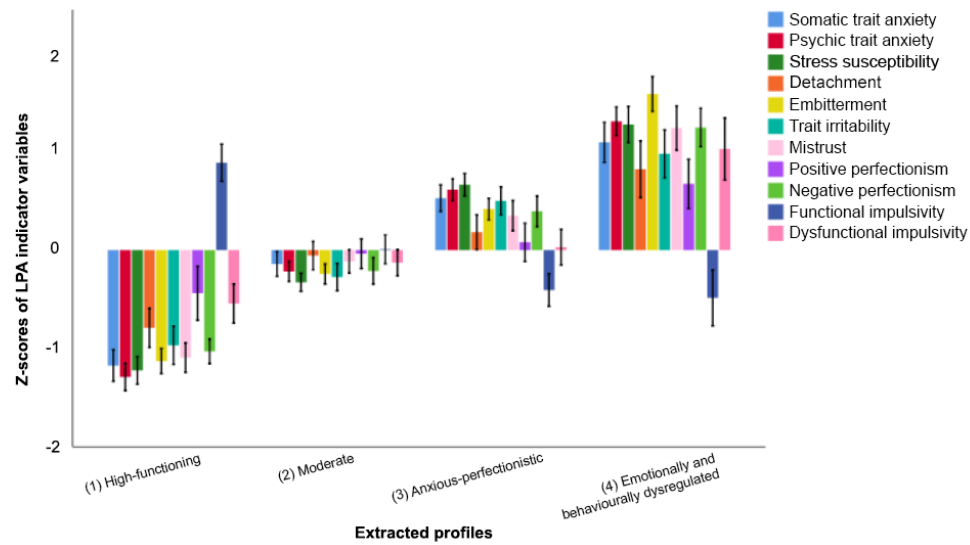
Figure 2

Z-scores with 95% confidence intervals in the 4-class total sample solution
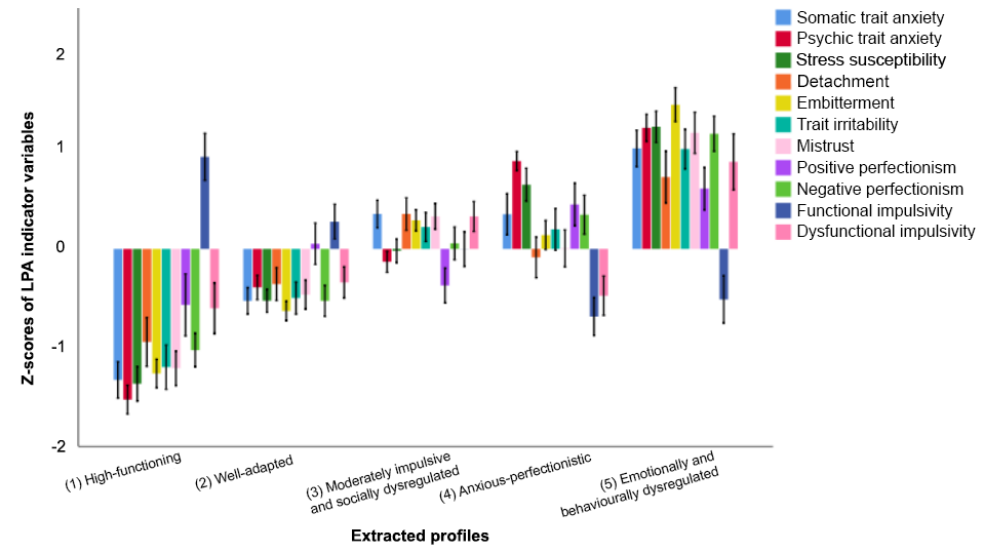
Figure 3

Z-scores with 95% confidence intervals in the 5-class total sample solution

Table 3

Comparison of means across indicator variables in the 5-class total sample

	Class					ANOVA		
	High-functioning (*n* = 56)	Well-adapted (*n* = 112)	Impulsive, socially dysregulated (*n* = 114)	Perfectionistic-anxious (*n* = 66)	Emotionally/behaviourally dysregulated (*n* = 72)			
	M(*SD*)	*M*(*SD*)	*M*(*SD*)	*M*(*SD*)	*M*(*SD*)	*df*	*F*	η^2
1. Somatic anxiety	44.16(7.02)[b, c, d, e]	52.27(7.14)[a, c, d, e]	63.16(7.60)[a, b, e]	63.27(8.77)[a, b, e]	70.72(8.42)[a, b, c, d]	4, 402	125.65[f]	.55
2. Psychic anxiety	39.23(5.76)[b, c, d, e]	52.57(6.74)[a, c, d, e]	55.65(6.16)[a, b, d, e]	67.66(4.15)[a, b, c, e]	71.47(6.22)[a, b, c, d]	4, 402	326.30[f]	.74
3. Stress susceptibility	40.74(6.85)[b, c, d, e]	50.43(6.66)[a, c, d, e]	57.00(7.20)[a, b, d, e]	65.22(7.40)[a, b, c, e]	71.42(7.58)[a, b, c, d]	4, 402	185.06	.65
4. Detachment	40.29(8.01)[b, c, d, e]	45.88(8.06)[a, c, e]	53.33(8.27)[a, b, d, e]	48.99(7.85)[a, c, e]	56.92(10.26)[a, b, c, d]	4, 402	39.40	.28
5. Embitterment	42.29(6.09)[b, c, c, e]	49.76(5.91)[a, c, d, e]	60.86(6.84)[a, b, e]	59.93(6.80)[a, b, e]	75.08(8.05)[a, b, c, d]	4, 402	208.84[f]	.70
6. Irritability	43.85(7.40)[b, c, d, e]	50.31(7.54)[a, c, e]	57.21(7.94)[a, b, e]	57.19(7.73)[a, b, e]	64.21(8.39)[a, b, c, d]	4, 402	68.57	.41
7. Mistrust	42.51(6.76)[b, c, d, e]	51.34(8.32)[a, c, d, e]	60.86(7.87)[a, b, d, e]	57.52(8.01)[a, b, c, e]	71.05(9.41)[a, b, c, d]	4, 402	112.48[g]	.53
8. Positive perfectionism	30.44(10.17)[b, d, e]	36.75(9.72)[a, c, e]	32.73(8.41)[b, d]	40.18(8.22)[a, c]	42.00(8.45)[a, b, c]	4, 376	19.02	.17
9. Negative perfectionism	6.21(7.71)[b, c, d, e]	13.00(10.07)[a, c, d, e]	19.75(10.89)[a, b, e]	24.15(9.73)[a, b, e]	34.79(9.23)[a, b, c, d]	4, 376	95.30[f, h]	.45
10. Functional impulsivity	30.22(7.39)[b, c, d, e]	24.08(7.08)[a, d, e]	22.25(7.41)[a, d, e]	15.57(6.23)[a, b, c]	17.49(7.95)[a, b, c]	4, 390	37.73	.28
11. Dysfunctional impulsivity	11.63(6.47)[c, e]	13.44(5.76)[c, e]	18.94(5.67)[a, b, d, e]	12.54(5.92)[c, e]	23.49(8.56)[a, b, c, d]	4, 391	36.34[e, i]	.31

Note. All means comparisons significant at *p* < .001, *post-hoc* tests at *p* < .05 (indicated by subscript).

[a] Statistically significantly different from the high-functioning class.

[b] Statistically significantly different from the well-adapted class.

[c] Statistically significantly different from the moderately impulsive and socially dysregulated group.

[d] Statistically significantly different from the perfectionistic-anxious group.

[e] Statistically significantly different from the emotionally and behaviourally dysregulated group.

[f] Welsch correction and Games-Howell test applied.

[g] The assumption of normality of distributions was violated; *H*(4) = 214.81, *p* < .001;

[h] The assumption of normality of distributions was violated; *H*(4) = 172.09, *p* < .001.

[i] The assumption of normality of distributions was violated; *H*(4) = 115.06, *p* < .001.

The 5-class model was also tested on a sample without controls – extracted profiles resembled those in the total sample, with the anxious-perfectionistic ($n = 66$) and emotionally and behaviourally dysregulated class ($n = 61$) remaining intact, the high-functioning ($n = 31$) and well-adapted classes ($n = 60$) reducing and the moderately impulsive and socially dysregulated ($n = 88$) class showing less embitterment, irritability and mistrust (Figure 4).
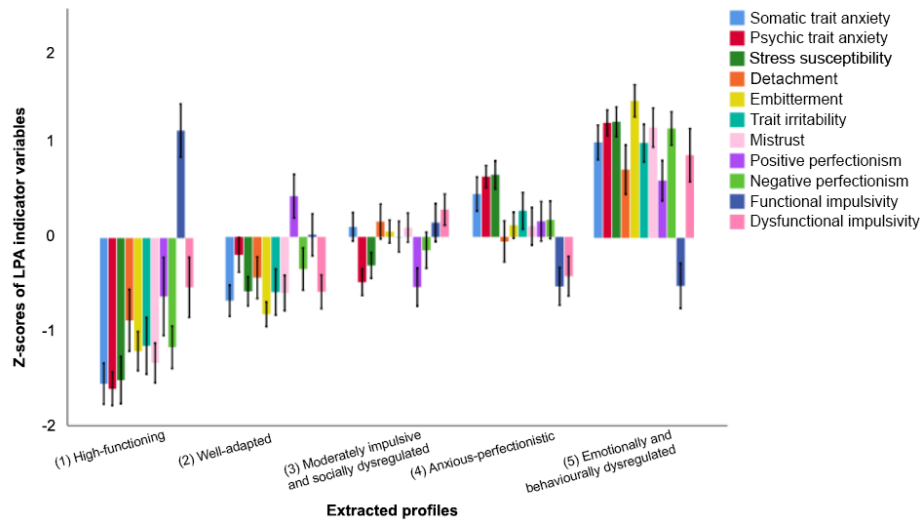
Figure 4

Z-scores with 95% confidence intervals in the 5-class sample without controls

Prevalence of disorders within classes in the total sample

To elucidate the nature of the extracted profiles, comorbidity rates and prevalence of disorders were analysed across classes. Results are presented in Tables 4–5.

Table 4

Proportion of comorbid diagnoses in the total sample across classes

Comorbid diagnoses (no)	Class					$\chi2(4)$
	High-functioning ($n = 56$)	Well-adapted ($n = 112$)	Impulsive, socially dysregulated ($n = 114$)	Anxious-perfectionistic ($n = 66$)	Emotionally/ behaviourally dysregulated ($n = 72$)	
0	35 (62.5%)[c, d, e]	48 (44.0%)[c, d, e]	24 (21.2%)[e]	5 (7.6%)[a, b]	2 (2.8%)[a, b, c]	88.42**
1	13 (23.2%)	29 (26.6%)	32 (28.3%)	17 (25.8%)	16 (22.2%)	0.97
2	5 (8.9%)	14 (12.8%)	22 (19.5%)	15 (22.7%)	13 (18.1%)	6.28
3	2 (3.6%)	7 (6.4%)	11 (9.7%)	13 (19.7%)	8 (11.1%)	11.55*
4–5	1 (1.8%)[c, d, e]	9 (8.3%)	19 (16.8%)[a]	14 (21.2%)[a]	13 (18.1%)[a]	15.21**
6–7	0 (0%)	1 (0.9%)[e]	5 (4.4%)[e]	2 (3.0%)[e]	14 (19.4%)[b, c, d]	37.44**
8–10	0 (0%)	1 (0.9%)[e]	0 (0%)	0 (0%)	6 (8.3%)[b]	23.94**

Note. Post-hoc tests significant at $p < .001$ (indicated by subscript).

[a] Statistically significantly different from high-functioning class.

[b] Statistically significantly different from well-adapted class.

[c] Statistically significantly different from impulsive, socially dysregulated class.

[d] Statistically significantly different from anxious-perfectionistic class.

[e] Statistically significantly different from emotionally and behaviourally dysregulated class.

*$p < .05$. **$p < .01$

Table 5

Prevalence of disorders in the total sample across profiles

Disorder	*n* (% *N*)	Class					$\chi^2(4)$
		High-functioning (*n* =56)	Well-adapted (*n* = 112)	Impulsive, socially dysregulated (*n* = 114)	Anxious-perfectionistic (*n* = 66)	Emotionally/behaviourally dysregulated (*n* = 72)	
1. *Anorexia nervosa*	121 (28.8%)	16 (28.6%)	27 (24.1%)	25 (21.9%)	26 (39.4%)	25 (34.7%)	8.72
2. *Bulimia nervosa*	107 (25.5%)	3 (5.4%)[c, d, e]	17 (15.2%)[c, e]	40 (35.1%)[a, b]	21 (31.8%)[a]	26 (36.1%)[a, b]	29.4**
3. Binge eating disorder	17 (4.0%)	1 (1.8%)[d]	2 (1.8%)	3 (2.6%)[a]	8 (12.1%)	4 (4.2%)	13.88**
4. Substance use disorder	53 (12.62%)	1 (1.8%)[e]	9 (8.0%)[e]	15 (13.2%)	9 (13.6%)	19 (26.4%)[a, b]	20.16**
5. Depression, dysthymia	157 (37.38%)	5 (8.9%)[c, d, e]	26 (23.2%)[d, e]	42 (36.8%)[e]	34 (51.5%)	46 (63.9%)[a, b, c]	55.44**
6. Bipolar disorder, mania	12 (2.96%)	0 (0%)	1 (0.9%)	4 (3.5%)	3 (4.5%)	5 (6.9%)	7.58**
7. GAD	78 (18.57%)	3 (5.4%)[d, e]	11 (9.8%)[d, e]	18 (15.8%)[e]	19 (28.8%)[a, b]	27 (37.5%)[a, b, c]	33.53**
8. Social phobia	64 (15.24%)	1 (1.8%)[d, e]	9 (8.0%)[e]	18 (15.8%)	14 (21.2%)[a]	22 (30.6%)[a, b]	26.69**
9. Agoraphobia	50 (11.90%)	1 (1.8%)[e]	5 (4.5%)[e]	16 (14.0%)	8 (12.1%)	20 (27.8%)[a, b]	26.64**
10. Panic disorder	29 (6.90%)	0 (0%)	1 (0.9%)[e]	9 (7.9%)	4 (6.1%)	15 (20.8%)[a]	21.95**
11. PTSD	23 (5.47%)	0 (0%)	4 (3.6%)[e]	2 (1.8%)[e]	2 (3.0%)[e]	15 (20.8%)[b, c, d]	40.13**
12. OCD	23 (5.47%)	0 (0%)	3 (2.7%)	10 (8.8%)	2 (3.0%)	8 (11.1%)	12.36*
13. Suicide risk	72 (17.1%)	1 (1.8%)[c, d, e]	10 (8.9%)[e]	20 (17.5%)[a, e]	14 (21.2%)[a]	27 (37.5%)[a, b, c]	36.41**
14. Controls	114 (27.14%)	35 (62.5%)[c, d, e]	48 (42.9%)[c, d, e]	24 (21.1%)[a, b, e]	5 (7.6%)[a, b]	2 (2.78%)[a, b, c]	85.92**

Note. Number of diagnoses and, in parentheses, proportion of class is presented. *Post-hoc* tests significant at *p* < .05 (indicated by subscript). GAD = generalised anxiety disorder; PTSD = post-traumatic stress disorder; OCD = obsessive-compulsive disorder.
[a] Statistically significantly different proportion of cases than high-functioning class.
[b] Statistically significantly different proportion of cases than well-adapted group.
[c] Statistically significantly different proportion of cases than moderately impulsive and socially dysregulated class.
[d] Statistically significantly different proportion of cases than anxious-perfectionistic class.
[e] Statistically significantly different proportion of cases than emotionally and behaviourally dysregulated class.
p < .05. **p* < .01.

Validation analysis

Classification certainty

 Classification certainty in the 5-class solution is captured by high entropy of .80. Class probabilities for the most likely latent class ranged between .81-.93, while the mean likelihood of individuals to belong to the second-best class ranged between .03-.11.

Split-sample validation

 LPAs were run on two validation samples of $n_1 = 208$ and $n_2 = 212$. For both samples, entropy indicated good fit (.86 and .85 respectively). In n_1, classes resembling the total sample emerged (Figure C_1 in Appendix C) – a high functioning ($n = 32$, 15.5%), well-adapted ($n = 74$, 35.7%), and behaviourally and emotionally dysregulated class were distinguishable ($n = 24$, 11.3%). In comparison to the anxious-perfectionistic class in the total sample, n_1 revealed a moderately anxious, socially dysregulated and perfectionistic class ($n = 67$, 32.4%) and a class highest in mistrust, embitterment and detachment, but low in dysfunctional impulsivity, hinting at the existence of an emotionally and socially, rather than behaviourally dysregulated class ($n = 10$, 4.7%).

 For n_2, the extracted profiles (Figure C_2 in Appendix C) more closely resembled the total sample solution, giving rise to a high-functioning ($n = 12$, 4.7%) and well-adapted ($n = 62$, 29.25%) class and an emotionally and behaviourally dysregulated class ($n = 41$, 19.3%). The remaining two classes mirrored the anxious-perfectionistic and moderately impulsive and socially dysregulated classes, with n_2 showing less pronounced levels of perfectionism in profile 4 ($n = 24$, 11.3%) and milder elevations on detachment, embitterment, irritability and dysfunctional impulsivity profile 3 ($n = 72$, 34.4%).

Alternative measure and external validation

 For alternative measure validation, profiles were compared across measures selected based on Aluoja et al. (2009). Alternative measure and external validation results are presented in Table 6.

Table 6

Mean and standard deviations of alternative measure and external validation variables across five profiles

	Class					ANOVA & Kruskal-Wallis H			
	High-functioning (n = 56)	Well-Adapted (n = 112)	Impulsive, socially dysregulated (n = 114)	Anxious-perfectionistic (n = 66)	Emotionally/behaviourally dysregulated (n = 72)	df	F	H(4)	η^2
	M(SD)	M(SD)	M(SD)	M(SD)	M(SD)				
Measure validation									
Impulsivity	53.19(9.05)[c,e]	54.34(10.77)[c,e]	63.40(9.78)[a,b,d]	57.79(9.75)[c,e]	67.74 (12.81)[a,b,d]	4, 270	17.32*	55.76*	.20
Trait anxiety	33.00(9.56)[b,c,d,e]	41.10(11.73)[a,c,d,e]	53.31(11.22)[a,b,e]	58.49(9.51)[a,b,e]	63.90(11.10)[a,b,c]	4, 273	52.40*	117.88*	.43
Consciousness	142.36(19.90)[c,e]	135.14(18.61)[c,e]	115.74(21.66)[a,b]	127.25(17.96)[e]	103.10(27.12)[a,b,d]	4, 128	13.47*	35.92*	.30
Neuroticism	54.45(24.84)[b,c,d,e]	77.95(18.19)[a,c,d,e]	95.93(17.34)[a,b,d,e]	112.37(22.13)[a,b,c,e]	139.9(16.11)[a,b,c,d]	4, 128	62.73*	85.19*	.66
Agreeableness	142.55(10.62)[c,e]	134.98(12.15)[c,d,e]	122.48(20.52)[a,b,d]	144.93(11.53)[b,c,e]	114.33(27.58)[a,b,d]	4, 53	10.69[f]*	35.29*	.28
Extraversion	122.19(20.28)[d,e]	119.02(20.05)[d,e]	109.74(20.86)[e]	97.81(26.03)[a,b,e]	91.62 (27.22)[a,b,c]	4, 128	9.16*	—	.20
External validation									
Depression	5.66 (5.25)[b,c,d,e]	12.41 (9.46)[a,c,d,e]	18.10 (9.30)[a,b,e]	20.31 (8.75)[a,b,e]	27.51 (10.01)[a,b,c,d]	4, 126	52.46[f]*	103.46*	.40
State anxiety	30.45 (10.81)[b,c,d,e]	39.91 (15.03)[a,c,d,e]	47.22 (13.17)[a,b,e]	50.66 (13.09)[a,b,e]	58.45 (13.62)[a,b,c,d]	4, 121	31.68[f]*	80.74*	.28
ER difficulties	30.47 (22.91)[b,c,d,e]	58.69 (25.05)[a,c,d,e]	85.58 (23.23)[a,b,e]	58.45 (13.62)[a,b,e]	112.32 (20.94)[a,b,c,d]	4, 160	54.28*	97.85*	.58
Dietary restraint	10.73 (8.07)[b,c,d,e]	16.00 (9.87)[a,d,e]	17.24 (10.24)[a,d,e]	22.83 (10.37)[a,b,c,e]	23.94 (9.43)[a,b,c]	4, 185	19.76[f]*	67.53*	.16
Bingeing	8.23 (7.33)[b,c,d,e]	13.56 (8.76)[a,c,e]	18.61 (9.47)[a,b]	17.80 (10.68)[a,b]	20.30 (12.25)[a,b]	4, 182	16.69[f]*	64.97*	.14
Purging	1.5 (3.86)[c,d,e]	2.85 (5.38)[c,e]	5.40 (6.48)[a,b]	5.14 (5.77)[a]	8.00 (6.97)[a,b]	4, 186	12.88[f]*	66.13*	.11
Preoccupation	9.07 (9.27)[b,c,d,e]	13.62 (10.42)[a,c,d,e]	19.33 (11.15)[a,b,d,e]	25.00 (10.94)[a,b,c,]	28.59 (9.59)[a,b,c]	4, 184	40.66[f]*	120.69*	.28

Note. *Post-hoc* tests significant at *p* < .05 (indicated by subscript). ER difficulties = emotion regulation difficulties; preoccupation = preoccupation with weight and body image.

[a] Statistically significantly different proportion of cases than high-functioning class.

[b] Statistically significantly different proportion of cases than well-adapted group.

[c] Statistically significantly different proportion of cases than moderately impulsive and socially dysregulated class.

[d] Statistically significantly different proportion of cases than anxious-perfectionistic class.

[e] Statistically significantly different proportion of cases than emotionally and behaviourally dysregulated class.

[f] Welsch correction and Games-Howell test applied.

p < .01.

Discussion

This study aimed to elucidate latent personality structure within a clinical sample to expand on previous research that has reverted to investigating specific disorder classes or focused on establishing full taxonomies. Thus, the study set out to test the hypothesis (H1) that profiles resembling personality-based classes detected in ED studies can be extracted on a mixed sample with mood and anxiety disorders, regardless of whether healthy controls are included. This hypothesis found support: five personality-based profiles emerged, including a high-functioning class with low anxiety, no social deficits and high functional impulsivity; a well-adapted class, differing from the high-functioning class quantitatively, rather than qualitatively; a moderately impulsive and socially dysfunctional class; an anxious-perfectionistic, and an emotionally and behaviourally dysregulated class. The model was partly defined by impulsivity and perfectionism, yet anxiety, embitterment, detachment, irritability, and mistrust also meaningfully contributed to class extraction, confirming H2. Additionally, the detected latent profiles differed across state anxiety, emotion regulation difficulties, depression and disordered eating behaviour (H3).

Emerged profiles

In extracting profiles, mixed evidence was found in favour of the 3- and 5-class models. In light of previous results showcasing an impulsive class, the 5-class solution was found best-fitting with the emergence of the moderately impulsive and socially dysregulated class, while remaining relatively parsimonious (e.g. Bohane et al., 2017). These results are in accordance with studies acknowledging negative affectivity, measured by trait anxiety and neuroticism, as a non-specific factor of psychopathology (e.g. Kotov et al., 2010). It was also found that not only impulsivity and perfectionism, but also interpersonal difficulties measured by embitterment, mistrust, irritability and detachment, differentiated profiles. Regardless of abundant support for such transdiagnostic factors in previous research, profiling analyses have, arguably, rarely included them, failing to distinguish between facets of negative affectivity that are other-directed (e.g. Hartmann et al, 2010; Judd et al., 2013).

The extracted 5-class solution resembles the prominent triune solution from ED studies with the high-functioning class reflecting low pathology, the anxious-perfectionistic class representing overcontrolled participants and the moderately impulsive and socially dysregulated, and emotionally and behaviourally dysregulated classes pointing towards insufficient control (Wildes & Marcus, 2013). However, findings from this thesis also revealed that a more nuanced approach is warranted. Firstly, similarly to Christian et al. (2021) and Boone et al. (2014), a large class with both high perfectionism and high

impulsivity emerged and secondly, following Soidla & Akkermann (2020), different manifestations of dysregulation were documented. Several similarities were found with the solution derived by Rossellini and Brown (2014): severe comorbid (here emotionally and behaviourally dysregulated) and negligible-mild (high-functioning and well-adapted) classes were detected in both studies, the anxious-perfectionistic class in the current study appeared to encapsulate facets of the mildly-neurotic and obsessed-worried classes, while the moderately impulsive and socially dysfunctional class in this thesis reflected a combination of the social-depressed and panic-somatic classes. Results diverged compared to Spinhoven et al. (2012) who also found support for a 5-class model (two resilient and three overcontrolled classes) on a mixed sample of controls and individuals with mood and anxiety disorders, yet did not report an undercontrolled high impulsivity class. The authors attribute this to their sample not including people with externalising problems (Spinhoven et al., 2012). However, results from the present study point towards individuals with anxiety and depression – syndromes typically categorised as internalising problems – also showcasing high levels of impulsivity. Dissimilar findings can result from Spinhoven et al. (2012) only using the Big Five factor-level traits as LPA indicators, thus failing to detect classes more sensitive to specific facets of low conscientiousness and neuroticism.

Since the participants of this study exhibited a wide range of psychopathology, comparisons with the HiTOP framework are warranted (Kotov et al., 2017). The HiTOP differentiates between an internalising spectrum characterised by anxiety, emotional lability and hostility, a spectrum of disinhibited externalising features, characterised by impulsivity, and a detachment spectrum with pronounced withdrawal, suspiciousness, and interpersonal passivity (Kotov et al., 2017). In this thesis, such traits combined to make up the extracted profiles, rather than fell into discrete classes, e.g. while the moderately impulsive and socially dysregulated class reflected more externalising/detachment pathology, individuals also exhibited heightened somatic anxiety. This indirectly points toward the HiTOP insufficiently accounting for unconventional symptom profiles and comorbidity between syndromes on different spectra.

Associated psychopathology

Elucidating the extracted profiles, diagnostic distribution across classes was meaningful. In the high-functioning class, the majority of individuals were healthy controls and while a third had also been diagnosed with an eating disorder, the class generally displayed low comorbidity. Eating disorders and depression were more prevalent in the well-adapted class, yet nearly half of the participants exhibited no pathology. These findings were

supported by the external validation analysis which revealed the high- and well-adapted class to have the lowest levels of depressive symptoms, state anxiety, emotion regulation difficulties and eating pathology. The finding that personality can be a protective factor in people with eating and mood disorders is expected, since resilient classes have emerged in many studies on clinical samples (e.g. Boone et al., 2014; Spinhoven et al., 2012). In comparison, Rossellini and Brown (2014) showed the low pathology classes to have most commonly been diagnosed with panic disorder and social phobia, yet differences might arise from the authors' sample not including healthy controls.

Comorbidity estimates increased for the moderately impulsive and socially dysregulated class which contained larger proportions of substance use disorder and eating disorder, especially *bulimia nervosa* patients – a predictable result based on previous literature (e.g. Westen & Harnden-Fischer, 2001). While the anxious-perfectionistic class contained less individuals with severe comorbidity, more than half of the class had been diagnosed with depression and a more than a quarter with generalised anxiety disorder. Although these two classes were found to be most similar among the three disordered classes, validation analyses suggested that the moderately impulsive and socially dysfunctional class had significantly lower levels of agreeableness, while the anxious-perfectionistic individuals had higher scores on restraint and preoccupation scales and accentuated conscientiousness. Finally, the emotionally and behaviourally dysregulated class exhibited the most severe impairment, as reflected by high comorbidity and symptom expression. This reflects findings of Christian et al. (2021) on a non-clinical sample who also showed the perfectionistic class to have heightened levels of restrictive eating and the impulsive and perfectionistic class to exhibit the most symptoms across all disorder groups, besides OCD (here, OCD was also more pronounced in the moderately impulsive and socially dysfunctional class).

Noteworthily, largest effect sizes among the external validation measures were demonstrated by comparison of profiles across emotion regulation difficulties. This is a significant finding, since emotion regulation itself has been implicated as a transdiagnostic process potentially serving as a basis for classification (Beauchaine & Zisner, 2019). In this study, emotion regulation variables were not used to extract classes due to the construct's multifaceted nature and mixed evidence on its role in explaining the structure of pathology, yet more attention should be paid to emotion regulation in the future (Cludius et al., 2020). Implication of emotion regulation difficulties could also help elucidate the mechanism behind a combination of high negative affectivity, perfectionism and impulsivity predicting the most

severe pathology – individuals are disposed to negative emotions and strive to manage them, yet fail due to lack of executive control.

Strengths and limitations

This thesis has several limitations. Firstly, although the size of the clinical sample is suitable for latent profile analysis, EDs were overrepresented in the sample. To account for potential sampling bias, all subsamples were profiled separately, revealing generally similar results, yet less pronounced impulsivity. Diagnostic distribution across classes showed that non-ED diagnoses did not discretely group together lending further support to sampling decisions and suggesting that the model is not ED-specific.

Secondly, some validator variable measures had a significant amount of missing data. To buffer the limitations missing data, only variables with data for 90% or more of all cases were included as indicators. Finally, since female young adults made up majority of the sample, results are not generalisable to a wider clinical population. More representative and larger samples should be comprised to allow for such conclusions.

Regardless of the limitations, this study meaningfully contributes to the discourse on dimensional personality-based characterisation of psychopathology. The study's strengths include differentiation between state and trait variables and comparative inclusion of 3- to 5-class models, ruling best model choice non-arbitrary. An additional strength is the usage of an array of validation strategies. Based on Aluoja et al., (2009) the alternative measure validation analyses was expected to reveal the high-functioning and well-adapted profiles to have high extraversion and agreeableness; the moderately impulsive and socially dysfunctional profile to exhibit high neuroticism, low extraversion and high impulsivity; the anxious-perfectionistic class to be characterised by high neuroticism and conscientiousness and the emotionally and behaviourally dysregulated class to show highest levels of neuroticism, impulsivity and lowest extraversion and agreeableness. These hypotheses found support. The split-sample validation yielded unexpected results: while the model emerging in one of the half-samples closely mimicked the total sample, the other sample failed to distinguish between an anxious-perfectionistic and an emotionally dysregulated group. Differences in the subsamples can arise from sampling bias and the smaller number participants included. Such results hint at the need to further validate the existence of separate impulsive and socially detached and anxious-perfectionistic classes. In the future, independent samples should be used for validation. However, considered together, the validation analyses offer support in concluding that there is preliminary evidence in favour of a 5-class model.

Clinical utility and future directions

Personality-based profiling can help elucidate associations between pathological symptomatology and address shortcomings of current diagnostic systems. In this study, it was revealed that no one-diagnosis-class emerged, hinting at within-disorder heterogeneity and cross-disorder homogeneity in individuals' latent personality profiles. Inclusion of controls in the total sample not changing the general profile configuration serves as evidence in favour of the included traits varying dimensionally across the population. This not only expands on the idea of thresholded binary assessments being insufficient but also sheds light on the fact that such traits common among non-clinical populations can indeed be used to characterise and clinically usefully predict pathology.

As suggested by Hopwood et al. (2020) in the context of the HiTOP framework, inclusion of analysis of personality traits in planning interventions is crucial. Although personality traits are temporarily more stable than state characteristics, reducing traits to fixed and unchangeable constructs in misleading. Since personality-based profiles significantly differed across state-level disturbance, early identification of risk traits could help buffer the vulnerability. Additionally, if negative affectivity reflects transdiagnostic risk, targeting this personality-based disposition itself could improve treatment outcome (Barlow et al., 2011)

Based on this thesis and its shortcomings, the following further directions are proposed. Firstly, for the extracted profile solutions to be reliable, sample sizes need to be increased to limit diagnostic distribution bias. Additionally, incorporation of larger samples would allow for more nuanced profiling via additional indicators: in this study, two dimensions of impulsivity (functional and dysfunctional) and perfectionism (positive and negative) were included, yet since positive perfectionism was found to differentiate between classes insufficiently, inclusion of more subscales is merited. Similarly, it has been shown that distinguishing between emotional, behavioural, and cognitive dimensions of impulsivity is useful and thus, the multifaceted construct could be modelled more adequately on a larger sample. Secondly, in this study, no measure for assessing general functioning was used. Although the number of comorbid diagnoses indirectly reflects severity of pathology, inclusion of a separate measure could not only help assess traits' ability to predict well-being but also serve as a more standardised assessment instrument.

Based on the findings of this study, dimensional psychiatry could be furthered in the three following ways. Firstly, after establishing the variables responsible for profiling solutions and variations in emotional state, more confirmatory approaches should be used to ascertain models' validity on different samples (Wiecki et al., 2015). Secondly, profiles

should be assessed longitudinally to, on the one hand, analyse temporal stability and class-crossover, especially in comparison with diagnostic migration in current nosologies. On the other hand, longitudinal studies are needed to assess whether class membership predicts treatment response. Finally, personality traits that distinguish between profiles and meaningfully impact symptomatology could serve as endophenotypes, of which biomarker identification studies could build on. Since, for example, dopaminergic and serotonergic pathways have widely been implicated as transdiagnostic bases for different types of psychopathology, relating the biological substrate of phenotypic variability to personality traits could further improve class separation and add explanatory power to personality-based cross-disorder models.

Conclusion

In conclusion, this thesis aimed to investigate personality-based latent profiles in a mixed sample of ED, mood and anxiety disorder patients and healthy controls to further the discussion on dimensional classification and address shortcomings of previous research, namely *a priori* conformation to existing diagnostic classes and failure to account for associations between extracted classes. It was hypothesised that three to five classes would emerge and that they would resemble the overcontrolled, undercontrolled and high-functioning class identified in ED studies, yet also meaningfully incorporate measures of anxiety, irritability, mistrust, detachment and embitterment. Classes were expected to differ in emotional state. Evidence in favour of these hypotheses was found and a 5-class model with high-functioning and well-adapted, moderately impulsive and socially dysfunctional, anxious-perfectionistic, and emotionally and behaviourally dysregulated profiles. Further studies on larger samples, especially longitudinal designs are warranted to assess treatment response and temporal stability of class solution.

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Appendix A

Descriptive statistics for indicator and validation variables for the total sample and subsamples

Appendix A

Means, standard deviations and comparisons of means tests for indicator, parallel measure and external validation variables across samples

Measured variable	n	Subsample ED (n = 249) M(SD)	MOOD-ANX (n = 64) M(SD)	Control (n = 114) M(SD)	ANOVA & Kruskal-Wallis H df	F	H(2)	η^2	Total N = 427 M(SD)
Somatic trait anxiety	407	60.69(11.37)[a]	63.79(11.03)[a]	53.29(9.62)[b, c]	2, 404	23.55	—	0.10	59.09(11.46)
Psychic trait anxiety	407	60.48(10.89)[a]	60.09(10.82)[a]	49.10(9.69)[b, c]	2, 404	46.27	—	0.19	57.33(11.69)
Stress susceptibility	407	59.39(12.09)[a]	61.11(10.40)[a]	49.47(8.70)[b, c]	2, 131	46.97[d]	—	0.15	56.92(11.94)
Detachment	407	51.50(9.76)[a]	50.22(10.31)[a]	45.02(8.80)[b, c]	2, 404	17.49	—	0.08	49.56(9.97)
Embitterment	407	60.34(11.78)[a]	61.61(10.99)[a]	49.60(9.52)[b, c]	2, 404	40.17	—	0.17	57.61(12.13)
Trait irritability	407	55.84(9.54)[a]	57.06(9.64)[a]	51.49(8.56)[b, c]	2, 404	9.66	—	0.05	54.82(9.75)
Mistrust	407	59.00(11.23)[a]	59.62(14.52)[a]	51.93(9.95)[b, c]	2, 131	18.85[d]	—	0.07	57.16(11.81)
Positive perfectionism	381	38.25(9.86)[a, c]	34.22(10.20)[b]	32.68(9.18)[b]	2, 378	13.98	—	0.07	36.24(9.82)
Negative perfectionism	381	21.78(13.42)[a]	25.85(11.68)[a]	10.76(8.59)[b, c]	2, 145	56.45[d]	—	0.17	19.42(13.20)
Functional impulsivity	395	20.66(8.19)[a]	19.72(8.35)[a]	26.32(7.82)[b, c]	2, 392	18.73	—	0.09	21.85(8.49)
Dysfunctional impulsivity	396	16.64(7.72)[a, c]	19.50(7.98)[a, b]	13.47(6.30)[b, c]	2, 143	14.14[d]	—	0.06	16.32(7.70)
BIS impulsivity	275	60.97(11.50)[a]	63.28(11.85)[a]	53.05(9.69)[b, c]	2, 272	13.52	—	0.09	59.86(11.74)
STAI trait anxiety	279	55.78(11.93)[a]	53.28(14.71)[a]	31.36(9.21)[b, c]	2, 111	74.34[d]	73.78	0.28	51.41(14.34)
Neuroticism[f]	133	109.82(29.51)	N/A	70.07(21.92)	130	8.91	—	1.52	92.19(32.95)
Extraversion[f]	133	99.77(24.48)	N/A	123.97(17.03)	129	–6.71	—	1.15	110.50(24.58)
Agreeableness[f]	133	129.62(23.04)	N/A	133.31(15.55)	128	–1.10	—	0.19	131.26(20.08)
Conscientiousness[f]	133	122.76(26.62)	N/A	129.63(21.57)	131	–1.61	—	0.28	125.80(24.66)
Depression	285	19.74(10.33)[a]	20.53(10.99)[a]	6.42(4.61)[b, c]	2, 138	105.2[d]	—	0.24	17.34(11.02)
Emotion regulation difficulties	165	90.77(24.04)[a]	91.98(26.02)[a]	21.25(20.21)[b, c]	2, 162	86.17	—	0.52	81.00(34.45)
STAI state anxiety	282	50.40(14.34)[a]	47.15(15.91)[a]	31.36(9.21)[b, c]	2, 125	67.01[d]	64.43	0.22	45.99(15.64)
Dietary restraint	419	22.78(10.12)[a, c]	11.07(7.97)[b]	11.78(6.87)[b]	2, 167	87.42[d]	115.76	0.28	18.08(10.60)
Bingeing	420	18.83(11.58)[a, c]	15.20(8.32)[a, b]	10.53(5.77)[b, c]	2, 167	42.10[d]	41.63	0.12	16.05(10.48)
Purging	419	7.51(7.38)[a, c]	1.74(2.96)[a, b]	0.33(1.19)[b, c]	2, 148	125.36[d]	143.66	0.27	4.60(6.19)
Preoccupation with weight	420	24.11(11.06)[a, c]	16.47(11.87)[a, b]	9.07(7.46)[b, c]	2, 153	114.00[d]	124.81	0.29	18.92(12.22)

Note. All meanss comparison tests significant at *p* < .01, *post-hoc* tests at *p* < .05. ED = eating disorder sample, MOOD-ANX = mood and anxiety disorder sample.

[a] Statistically significantly different from the control group.

[b] Statistically significantly different from the ED group.

[c] Statistically significantly different from the MOOD-ANX group.

[d] Welsch correction and Games-Howell test applied.

[f] t-tests were conducted, the t-statistic and Cohen's *d* are reported.

Appendix B
Model fit statistics and 5-class models across subsamples

Table B₁

Fit indices for 1–8 class LPA models in the control sample

No	LL	AIC	BIC	SABIC	ENT	%	LMR	BLRT
1	−4178.07	8400.14	8460.34	8390.80	—	—	—	—
2	−4067.34	8202.68	8295.71	8188.25	0.91	32.5%	<0.0001	<0.0001
3	−4029.97	8151.94	8277.81	8132.42	0.88	13.8%	0.07	<0.0001
4	−3994.08	8104.15	8262.85	8079.53	0.90	5.3%	0.16	<0.0001
5	−3978.24	8096.48	8288.01	8066.77	0.92	5.3%	0.78	0.50
6	−3965.77	8095.54	8319.91	8060.73	0.92	1.8%	0.36	1.00
7	−3949.05	8086.09	8343.30	8046.19	0.90	1.8%	0.77	0.33
8	−3933.97	8079.94	8369.98	8034.95	0.91	1.8%	0.76	0. 60

Note. For analyses with different numbers of starts, the relative order of all fit indices remained the same, with the exception of a larger number favouring the 8-class solution in AIC and SABIC. No = Number of classes in tested model; LL = log likelihood; AIC = Akaike's Information Criterion; BIC = Bayesian Information Criterion, SABIC = sample-adjusted Bayesian information criterion; ENT = entropy, % = smallest class %; LMR = adjusted Lo-Mendell-Rubin likelihood ratio test; BLRT = bootstrap likelihood ratio test.
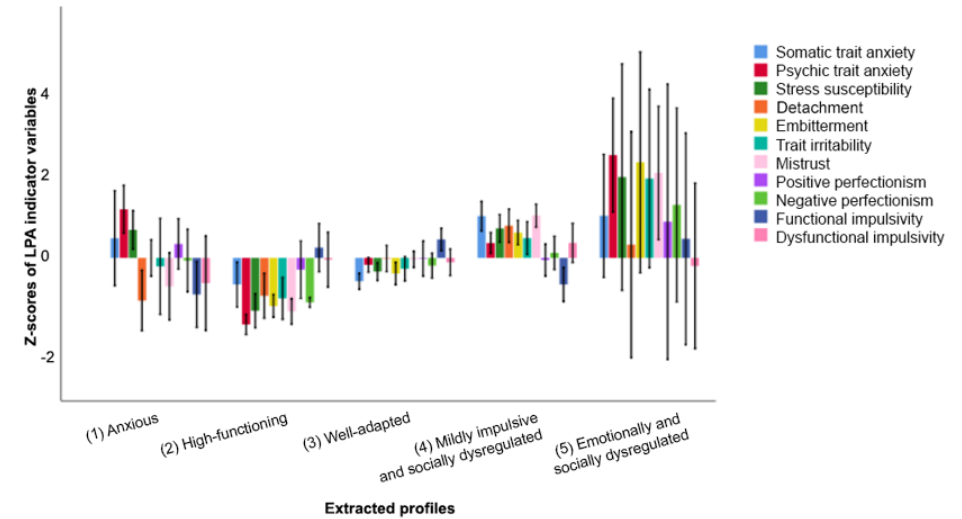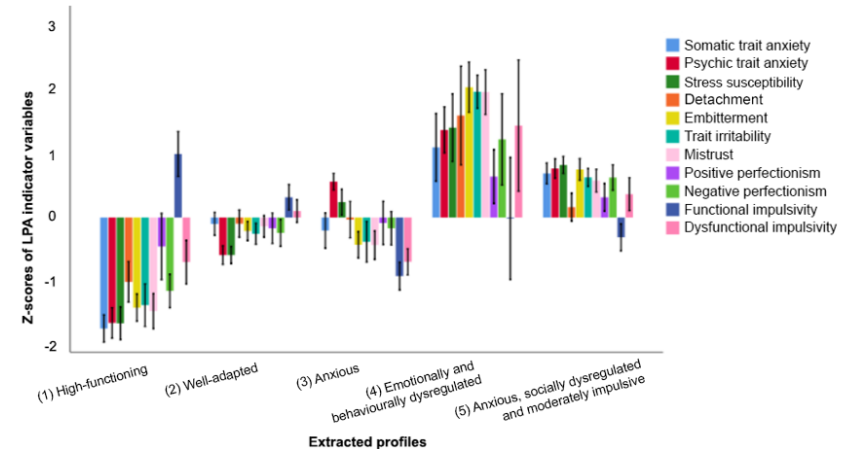

Figure B₁

Z-scores with 95% confidence intervals in the 5-class control sample with preliminary class labels

Table B₂

Fit indices for 1–8 class LPA models in the MOOD-ANX sample

No	LL	AIC	BIC	SABIC	ENT	%	LMR	BLRT
1	−2,305.91	4,655.83	4,792.27	4,633.06	—	—	—	—
2	−2,233.29	4,534.58	4,606.35	4,499.40	0.89	27.9%	.03	<.001
3	−2,207.68	4,507.36	4,604.46	4,459.75	0.86	23.0%	.66	<.01
4	−2,190.03	4,496.06	4,618.49	4,436.04	0.87	11.5%	.45	.04
5	−2,173.36	4,486.72	4,634.48	4,414.27	0.91	4.9%	.24	.16
6	−2,155.59	4,475.18	4,648.27	4,390.32	0.91	6.6%	.76	.20
7	−2,141.46	4,470.92	4,669.35	4,373.64	0.92	4.9%	.61	.50
8	−2,123.31	4,458.62	4,682.37	4,348.92	0.92	4.9%	.84	.18

Note. No = Number of classes in tested model; LL = log likelihood; AIC = Akaike's Information Criterion; BIC = Bayesian Information Criterion, SABIC = sample-adjusted Bayesian information criterion; ENT = entropy, % = smallest class %; LMR p = adjusted Lo-Mendell-Rubin likelihood ratio test; BLRT p = bootstrap likelihood ratio test.

Table B₃

Fit indices for 1–8 class LPA models in the ED sample

No	LL	AIC	BIC	SABIC	ENT	%	LMR	BLRT
1	−9,852.55	19,749.11	19,826.13	19,756.40	—	—	—	—
2	−9,569.06	19,206.12	19,325.17	19,217.39	.83	36.3%	.08	<.001
3	−9,427.21	18,946.42	19,107.47	18,961.66	.88	13.9%	.008	<.001
4	−9,382.72	18,881.48	19,084.55	18,900.69	.87	4.9%	.39	<.001
5	−9,351.50	18,843.01	19,088.10	18,866.20	.84	4.5%	.67	<.001
6	−9,325.07	18,814.14	19,101.24	18,841.31	.83	4.1%	.51	<.00 1
7	−9,298.68	18,785.25	19,114.37	18,816.40	.84	3.3%	.52	<.001
8	−9,277.36	18,766.73	19,137.86	18,801.85	.85	2.9%	.31	<.001

Note. No = Number of classes in tested model; LL = log likelihood; AIC = Akaike's Information Criterion; BIC = Bayesian Information Criterion, SABIC = sample-adjusted Bayesian information criterion; ENT = entropy, % = smallest class %; LMR p = adjusted Lo-Mendell-Rubin likelihood ratio test; BLRT p = bootstrap likelihood ratio test.
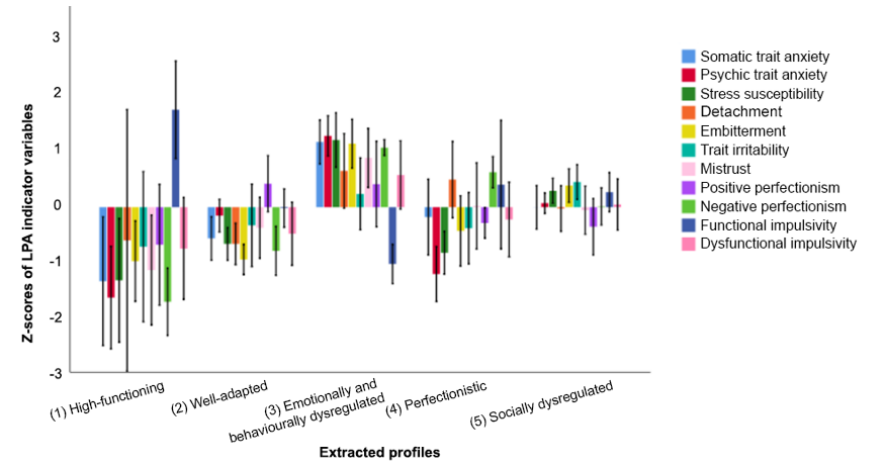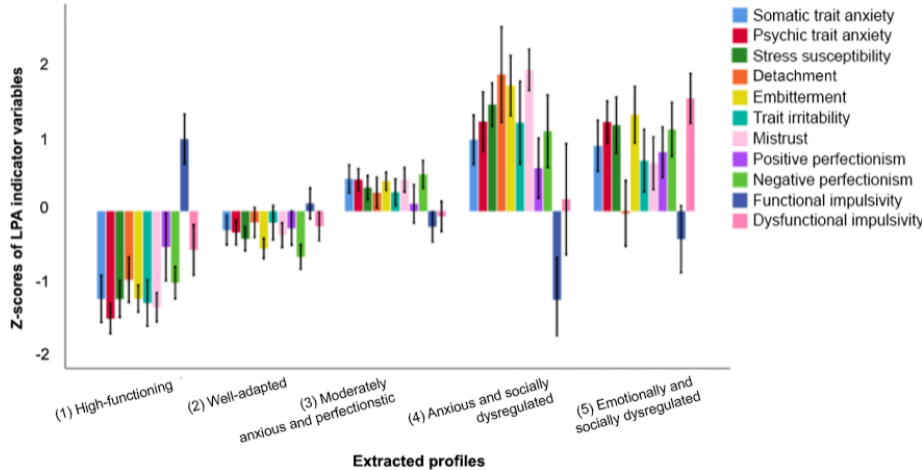

Figure B₂

Z-scores with 95% confidence intervals in the 5-class MOOD-ANX with preliminary class labels
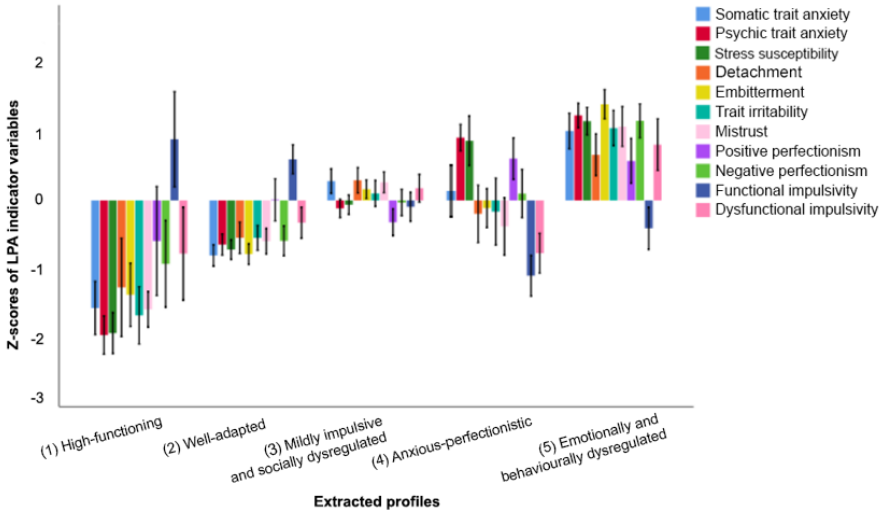

Figure B₃

Z-scores with 95% confidence intervals in the 5-class ED sample with preliminary class labels

Appendix C
5-class solutions in the split-sample validation analysis

Figure C₁

Z-scores with 95% confidence intervals in the 5-class first split-sample n₁ with preliminary class labels

Figure C₂

Z-scores with 95% confidence intervals in the 5-class second split-sample n₂ with preliminary class labels

Acknowledgements