Predicting Depression Outcomes Throughout Inpatient Treatment Using the General and Specific Personality Disorder Factors

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Abstract

Background

Clinical intuition suggests that personality disorders hinder the treatment of depression, but research findings are mixed. One reason for this might be the way in which current assessment measures conflate general aspects of personality disorders, such as overall severity, with specific aspects, such as stylistic tendencies. The goal of this study was to clarify the unique contributions of the general and specific aspects of personality disorders to depression outcomes.

Methods

Patients admitted to the Menninger Clinic, Houston, between 2012 and 2015 (N = 2,352) were followed over a 6-8 week course of multimodal inpatient treatment. Personality disorder symptoms were assessed with the Structured Clinical Interview for DSM-IV Axis II Personality Screening Questionnaire (SCID-II-PSQ) at admission, and depression severity was assessed using the Patient Health Questionnaire-9 (PHQ-9) every fortnight. General and specific personality disorder factors estimated with a confirmatory bifactor model were used to predict latent growth curves of depression scores in a structural equation model.

Results

The general factor predicted higher initial depression scores but not different rates of change. By contrast, the specific borderline factor predicted slower rates of decline in depression scores, while the specific antisocial factor predicted a U-shaped pattern of change.

Conclusions

Personality disorder symptoms are best represented by a general factor that reflects overall personality disorder severity, and specific factors that reflect unique personality

styles. The general factor predicts overall depression severity while specific factors predict poorer prognosis which may be masked in prior studies that do not separate the two.

Keywords. personality disorder, depression, treatment outcomes, comorbidity, bifactor

With clinical depression ranked as the world's leading cause of disability (World Health Organization, 2017), there is a pressing need to understand predictors of prognosis. One important aspect of depression is that it frequently co-occurs with other disorders, including personality disorders (Friborg et al., 2014). Patients diagnosed with a comorbid personality disorder (PD) show a more severe and persistent course of depression when left untreated (Cyranowski et al., 2004; Grilo et al., 2010). Clinical intuition suggests that PDs hinder treatment for depression (Clarkin, Petrini, & Diamond, 2019). Yet, results from meta-analyses are mixed: some support the link between PDs and poorer depression outcomes (Newton-Howes, Tyrer, & Johnson, 2006; Newton-Howes et al., 2013; Reich, 2003) while others not (Kool et al., 2005; Mulder, 2002).

Studies vary widely in their choice of treatments, outcome measures, and sample characteristics, making any task of aggregating findings challenging and inconclusive (French, Turner, Dawson, & Moran, 2017). However, a consistent finding is that controlled studies tend to report a weaker relationship between PDs and depression outcomes (Mulder, 2002). For instance, controlling for baseline depression severity often negates the adverse effect of PDs on depression outcomes (De Bolle et al., 2010; Erkens et al., 2018; van Bronswijk et al., 2018). This implies that PDs are associated with higher depression scores throughout treatment, but the pattern of change is no different to patients without a PD diagnosis (Fowler et al., 2018; Moradveisi, Huibers, Renner, Arasteh, & Arntz, 2013). In short, a PD diagnosis does not alter general responses to treatment; it just predicts a poorer start.

Another issue concerns the measurement validity of PDs. PDs are assessed using categorical criteria that represent distinct entities, but comorbidity rates among PDs are too high to be considered truly distinct (Tyrer, Reed, & Crawford, 2015). Predicting depression outcomes from the presence of a specific personality disorder would conflate the unique

aspects of that disorder with aspects shared with other disorders. As Mulder (2002) put it, "Classification problems mean that it remains unclear whether personality disorder categories are a general measure of personality pathology affecting outcome or whether individual categories, or clusters, predict different outcomes." (p. 366). Unless the general and specific aspects of PDs are separated out, it is uncertain how each contributes to depression outcomes.

A statistical method for separating out the general and specific aspects of a measure is the bifactor model (Markon, 2019). In this factor analytic model, the covariance among a set of items is attributed to a general latent variable or 'factor' that summarizes the common variance among items, as well as specific factors that summarize the covariance among specific clusters of items (Reise, 2012). Put differently, responses to each item are decomposed for the variance associated with a general underlying construct, as well as the variance associated with specific constructs. These sources of variance are considered orthogonal, that is, the specific factors reflect distinct constructs not explained by the general construct (Chen, West, & Sousa, 2006).

A growing number of studies have shown that the positive correlations among PD symptom ratings or diagnoses are best explained by a general PD factor, as well as specific factors that reflect individual PDs or PD clusters (Conway, Hammen, & Brennan, 2016; Jahng et al., 2011; Sharp et al., 2015; Williams, Scalco, & Simms, 2017; Wright, Hopwood, Skodol, & Morey, 2016). The general PD factor is thought to reflect the severity of individuals' personality dysfunction on a continuum (Sharp et al., 2015), and predicts social functioning, occupational functioning, treatment use, and suicidality (Conway et al., 2016). The meaning of the specific factors is less clear, but they are thought to reflect stylistic expressions of disturbance (Wright et al., 2016). While the bifactor model is primarily a statistical tool for estimating the general and specific variance within a measure, it also maps

onto alternative nosologies of PD that separate out severity and style (Skodol et al., 2011b; Tyrer et al., 2011).

The mixed predictive value of PDs for depression outcomes might result from current PD measures conflating two sources of variance–general and specific personality pathology–that differ in their direction of influence. For instance, if general PD reflects overall illness severity, then it may predict higher depression scores overall, giving the impression that PDs predict poorer outcomes. However, if general PD or its sequelae are controlled for (e.g., via baseline randomization or covarying baseline depression severity), then depression scores might normalize, giving the impression that PDs do not predict poorer outcomes. In either case, general PD would predict the overall severity of depression, not the rate of change. Specific PD factors might reflect stylistic expressions that predict differential rates of change, but these effects are masked by general PD severity. We tested this hypothesis by estimating the unique contribution of general and specific PD factors to changes in depression severity over an inpatient treatment using the bifactor model and latent growth models.

Method

Participants

The sample consisted of 2,352 inpatients admitted to the Menninger Clinic, Houston, between June 2012 and June 2015. Full demographics are presented in Table 1. Patients were mostly White/Caucasian American (89%), middle aged (M = 35, SD = 15), and a mix of sexes (48% female). Most participants underwent some form of higher education, including some college (35%), completing a Bachelor's, Technical or Associates Degree (33%), or attaining a postgraduate degree or doctorate (21%). There were no exclusion criteria; participants of all diagnoses and severity levels were recruited and included in the analysis. Over half (56%) of patients reported moderately severe or severe depression on the Patient Health Questionnaire-9 (PHQ-9). Data were collected as part of the hospital's ongoing Adult

Outcomes Project, which aims to integrate research and routine clinical practice (Allen et al., 2009). Collection and use of all data were approved by Baylor College of Medicine's Institutional Review Board (IRB).

Rates of DSM-IV PDs were as follows: borderline personality disorder (19%), avoidant personality disorder (16%), obsessive-compulsive personality disorder (9%), antisocial personality disorder (3%), narcissistic personality disorder (2%), and schizotypal personality disorder (0.4%). Note that histrionic, schizoid, dependent and paranoid PDs showed prevalence rates of < .01% in our pilot samples (N = 1,200), so we limited their assessment to ensure a complete assessment of the remaining PDs. This is also consistent with the main PD types included in the DSM-5 Section III (American Psychiatric Association, 2013). Of the 31% of patients meeting the criteria for any PD, 34% met the criteria for at least one other PD.

Measures

Personality disorder symptoms were assessed within 72 hours of admission using the Structured Clinical Interview II for DSM-IV Personality Disorders Screening Questionnaire (SCID-II-PSQ; First et al., 1994). Seven-to-nine symptoms for antisocial, avoidant, borderline, narcissistic, obsessive-compulsive, and schizotypal personality disorders were rated by patients with a 'yes' (threshold or true) or 'no' (subthreshold, false or absent). Internal consistency was acceptable or near acceptable for most disorders ($\alpha_{narcissistic}$ = .66, $\alpha_{avoidant}$ = .74, $\alpha_{borderline}$ = .75, $\alpha_{antisocial}$ = .86), except for two ($\alpha_{obsessive}$ = .56, $\alpha_{schizotypal}$ = .51). We analysed the antisocial behaviour items after the age of 15; a diagnosis of conduct disorder was not required.

Depression symptoms were assessed at admission and every fortnight until discharge with the PHQ-9 (Kroenke, Spitzer, & Williams, 2001). The PHQ-9 is a screening

questionnaire based on the DSM-IV criteria for major depressive disorder. Patients rated the frequency of depressive symptoms over the past fortnight on a Likert scale ranging from 0 (not at all) to 3 (nearly every day). Responses were then summed to form total depression scores. The PHQ-9 shows excellent criterion validity, with sensitivity and specificity rates for detecting depression of 88% or more (Kroenke, Spitzer, Williams, & Löwe, 2010; Manea, Gilbody, & McMillan, 2015). The internal consistency in our sample averaged across each assessment period was excellent (α = .90; range = .89-.91).

Intervention

Patients were admitted to one of four inpatient programs: Compass (31%) for young adults (18-24); Comprehensive Psychiatric Assessment Service (CPAS; 18%) for adults in crisis; Hope (27%) for adults with more chronic difficulties; and Professionals in Crisis (PIC; 24%) for professionals with long-standing disorders. All programs were multimodal and equally intensive, consisting of individual and group psychotherapy, psychoeducation, social and recreational activities, family work, psychopharmacology and medication management, general psychiatric and medical care, and continuous nursing care. Patients were treated by multidisciplinary teams composed of psychiatrists, psychologists, social workers, psychiatric nurses, and rehabilitation specialists. Patients stayed for 6 weeks on average (*SD* = 3 weeks).

Data Analysis

Confirmatory Factor Analysis

Our bifactor model included a general factor with loadings from all PD items, as well as six orthogonal specific factors each with loadings from a single PD. The general and specific factors were uncorrelated. We compared the bifactor model to a single-factor model, which included a single factor with loadings from all PD items, and correlated factors model,

which included six correlated factors each representing a PD diagnosis with no cross-loadings.

Models were estimated using the robust maximum-likelihood estimator and compared using information criteria that penalize for model complexity based on the number of freely estimated parameters. Models were also estimated with robust weighted least squares to assess their global fit, and factor reliabilities were evaluated with model-based reliability indices. Further details can be found in Supplement 1. Confirmatory factor analyses were run in Mplus 8.0 (Muthén & Muthén, 2017).

Latent Growth Model

We used latent growth curve models to estimate the PHQ-9 symptom trajectories over the 2-8 week course of inpatient treatment. We compared three models: an unconditional model with growth factors only, a part conditional model with growth factors, bifactor PD factors, and clinical covariates, and a full conditional model with growth factors, bifactor PD factors, clinical covariates, and demographic covariates. We also re-ran these models using the correlated PD factors (see Supplement 2). In all models, PHQ-9 scores at admission were included as a covariate to control for baseline differences in severity other than those attributed to general PD, as well as the spurious effects of repeated measures e.g., regression to the mean (Chou, Chi, Weisner, Pentz, & Hser, 2010).

In the unconditional growth model, we estimated an intercept factor with loadings from observed PHQ-9 scores at weeks 2-8 fixed to one, and a linear slope factor with loadings from PHQ-9 scores at weeks 2-8 reflecting a linear increase in time (week 2 scores = 0, week 4 scores = 1, week 6 scores = 2, week 8 scores = 3). We then tested whether adding a quadratic slope factor, whose loadings reflected non-linear increments in time (e.g., week 2 = 0, week 4 = 1, week 6 = 4, week 8 = 9), improved the model fit using information criteria.

The model included growth factor variances that reflect heterogeneity in the intercept and slopes. The intercept and slope growth factors were freely correlated.

In the part conditional growth model with PD factors and clinical covariates, the best-fitting growth factors from the unconditional model were regressed onto the general and specific PD factors (antisocial, avoidant, borderline, narcissistic, obsessive, and schizotypal). Growth curves and PD factors were estimated within the same structural equation model. Growth factors were also regressed onto the clinical covariates, including PHQ-9 scores at admission, length of inpatient stay, number of prior admissions (first admission vs. one or more prior admissions), and inpatient program (HOPE vs. Compass; CPAS vs. Compass; PIC vs. Compass). All covariates were centred.

In the full conditional model with PD factors, clinical covariates, and demographic covariates, the growth factors were regressed onto the general and specific PD factors, clinical covariates, and demographic variables, including age at admission, sex, ethnicity (White/Caucasian vs. all other ethnic groups), highest level of education obtained (up to some college vs. bachelor's degree or beyond), and marital status (married vs. not marred/separated). All covariates were centred.

Growth models were run in Mplus 8.0 using the MLR estimator (Muthén & Muthén, 2017). Missing data was mainly a function of the length of inpatient stay (e.g., those who were discharged before the 8-week period showed missing responses up to that point). Given that we could explain the cause of missingness, we assumed that missing responses were Missing at Random and were handled with full-information maximum likelihood. Length of inpatient stay was included as a covariate in all models.

Results

Confirmatory Bifactor Analysis

Full details of the bifactor analysis, including model fit indices, factor loadings, and model comparisons, can be found in Supplement 1 and Tables S1-S2. Briefly, the bifactor model showed a good fit that outperformed the correlated factor and single-factor models. The general factor showed healthy loadings and was well represented by its indicators. There was some variation in specific factor reliability: avoidant and borderline PD items loaded more strongly onto the general PD factor than the specific avoidant and borderline factors, respectively, reducing their reliability, whereas antisocial and narcissistic PD items overlapped least with the general variance and hence represented the antisocial and narcissistic factors well.

Latent Growth Models

An unconditional growth model with an intercept and linear slope factor showed a good-to-excellent fit (CFI = .96, TLI = .95, RMSEA = .07, SRMR = .02). Adding a quadratic slope factor improved the information explained (ΔAIC = 68; ΔBIC = 45; ΔaBIC = 58; model fit: CFI = 1, TLI = 1, RMSEA = 0, SRMR = 0). We report unstandardized coefficients for the intercept factor (η_0), slope factor (linear = η_1, quadratic = η_2), latent variance components (ζ_0, ζ_1, ζ_2), and regression weights (b_0, b_1, b_2). The intercept (e.g., the estimated mean PHQ-9 score at week 2) in the unconditional model with both linear and quadratic slope factors fell just under the PHQ-9's clinical threshold for major depression (η_0 = 9.56, z = 66.39, p < .001, 95% CI [9.27, 9.84]), but patients varied substantially around the mean (ζ_0 = 37.56, z = 13.13, p < .001, 95% CI [31.94, 43.16]). On average, patients showed a linear decline in PHQ-9 scores over the treatment period (η_1 = -2.40, z = -16.87, p < .001, 95% CI [-2.68, -2.12]), but varied in the steepness of their individual slopes (ζ_1 = 13.76, z = 3.81, p < .001, 95% CI [6.67, 20.83]). The rate of decline in PHQ-9 scores slowed with time (η_2 =

0.34, z = 6.81, p < .001, 95% CI [0.24, 0.43]), but patients varied in the extent of this quadratic pattern of change (ζ_2 = 1.09, z = 3.28, p < .001, 95% CI [0.44, 1.74]).

In the part conditional growth model with the general and uncorrelated specific PD factors and clinical covariates, the intercept (η_0 = 9.31, z = 82.29, p < .001, 95% CI [9.09, 9.53]), linear slope (η_1 = -2.41, z = -11.90, p < .001, 95% CI [-2.81, -2.02]), and quadratic slope (η_2 = 0.30, z = 3.60, p < .001, 95% CI [0.14, 0.46]) were similar to the unconditional model. Higher general PD factor scores predicted higher intercept values (b_0 = 1.16, z = 6.49, p < .001, 95% CI [0.81, 1.51]), while lower intercept values were predicted by marginally higher borderline scores (b_0 = -0.49, z = -1.86, p = .062, 95% CI [-1.00, 0.03]), higher antisocial scores (b_0 = -0.55, z = -2.14, p = .032, 95% CI [-1.05, -0.05]), and higher narcissistic scores (b_0 = -0.38, z = -1.96, p = .050, 95% CI [-0.77, 0]). The general PD factor did not predict significant differences in the steepness of the linear slopes (b_1 = -0.09, z = -0.42, p = .678, 95% CI [-0.53, 0.35]). By contrast, higher borderline scores predicted flatter linear slopes (b_1 = 0.58, z = 1.97, p = .049, 95% CI [0.01, 1.16]), while higher antisocial scores predicted a stronger quadratic (i.e. U-shaped) pattern of growth (b_2 = 0.25, z = 2.26, p = .024, 95% CI [0.03, 0.46]). Regression coefficients for the clinical covariates were similar to those in the full conditional growth model (see below).

In the full conditional growth model with bifactor PD factors, clinical covariates, and demographic covariates, the growth factors were almost identical to the part conditional growth model (see Table S1). Higher intercept values were again predicted by higher general PD scores (b_0 = 1.14, z = 6.36, p < .001, 95% CI [0.79, 1.49]), lower borderline scores (b_0 = -0.64, z = -2.47, p = .013, 95% CI [-1.14, -0.13]), and lower antisocial scores (b_0 = -0.51, z = -1.99, p = .047, 95% CI [-1.02, -0.01]). The association between general PD and the linear slope strengthened but did not reach significance (b_1 = -0.22, z = -0.96, p = .340, 95% CI [-

0.66, 0.23]). Moreover, the association between borderline scores and linear slopes decreased slightly but was now marginal (b_1 = 0.52, z = 1.75, p = .08, 95% CI [-0.06, 1.11]), while the association between antisocial scores and quadratic slopes increased slightly and remained significant (b_2 = 0.26, z = 2.36, p = .018, 95% CI [0.04, 0.47]). Figure 1 shows the growth curves predicted by the general, borderline, and antisocial factors, and Table S3 shows the regression coefficients for the remaining PD factors, clinical covariates, and demographic covariates.

Discussion

Research findings are mixed as to whether PDs predict poorer outcomes following treatment for depression. One problem is that current assessment measures conflate what is shared among PDs (i.e., severity) with what is specific to particular PDs (i.e. style; Hopwood et al., 2011). These two sources of variance might predict depression outcomes in opposite directions, which could contribute to the mixed findings. We investigated the unique contributions of the general and specific components of personality pathology to depression prognosis by first separating out these two sources of variance with the bifactor model, and then using the resultant general and specific PD factors to predict changes in depression severity over an inpatient treatment using latent growth models.

Consistent with past studies, we found that the covariation in PD symptom reports was best summarized by a general PD factor, as well as specific factors reflecting each PD assessed (Conway et al., 2016; Jahng et al., 2011; Sharp et al., 2015[1]; Williams et al., 2017; Wright et al., 2016). Furthermore, borderline items (e.g., ‘identity disturbance’, ‘empty’), avoidant items (e.g., ‘preoccupied with rejection’, ‘views self as inept’), and schizotypal items (‘ideas of reference’, ‘social anxiety’) loaded most strongly onto the general PD factor[2] (Conway et al., 2016; Sharp et al., 2015; Williams et al., 2017; Wright et al., 2016),

supporting the idea that general PD reflects overall dysfunction in self-functioning (e.g., an incoherent or inadequate sense of identity) and interpersonal functioning (e.g., a general insecurity or mistrust of others). The general PD factor predicted higher initial depression scores, but not differential rates of change. By contrast, the specific borderline factor predicted slower rates of decline over the over the treatment period, while the antisocial factor predicted a U-shaped pattern of change.

Prognostic Value of the General and Specific PD factors

Higher general PD scores predicted higher initial depression scores two weeks into an eight-week inpatient treatment but did not predict significant differences in the growth curves. In other words, the common variance among PD symptoms predicted more severe depression but similar rates of change. This suggests that the general PD factor captures overall illness severity, which is not in itself a strong prognostic predictor. Prior studies have also reported higher depression scores in the presence of a PD (Fowler et al., 2018; Moradveisi et al., 2013), which normalizes after baseline depression severity–a marker of overall illness severity–is controlled for (De Bolle et al., 2010; Erkens et al., 2018; van Bronswijk et al., 2018). If general severity is not controlled for, the associated rise in depression scores may be misinterpreted as the negative effect of PDs on depression outcomes. But if it is, PDs will be said to have no prognostic value for depression outcomes. The mixed findings regarding the prognostic value of PDs on depression outcomes might be explained largely by the extent to which the effect of general severity is controlled for (Mulder, 2002).

Higher specific borderline factor scores were associated with lower initial depression scores and flatter linear slopes. That is, once the effect of general PD and the other specific PD factors was controlled for, borderline features (i.e. Negative Affectivity; see Supplement

1) predicted slower changes throughout an inpatient treatment. This is particularly interesting given that another study using an overlapping dataset reported that a BPD diagnosis, while associated with higher initial depression scores, was not associated with different rates of change (Fowler et al., 2018). If anything, patients with a BPD diagnosis showed better absolute outcomes, in that their depression scores dropped a larger amount to reach a similar endpoint to those without a BPD diagnosis. Our study suggests that the increased baseline severity associated with BPD was in fact a function of general PD severity. Only once the common variance in PD ratings is separated from the specific variance do we find that stylistic borderline features are associated with poorer depression outcomes.

How should we interpret the specific effect of borderline features on depression outcomes, if the general PD factor also reflects characteristics associated with borderline difficulties (Clark, Nuzum, & Ro, 2018)? One idea is that the general PD factor represents the non-specific ways in which disturbances in self and interpersonal functioning manifest across PDs, while the specific borderline factor reflects personality tendencies that explicitly feature these themes, such as a fragile (or malleable) identity and interpersonal sensitivity. When these personality tendencies interfere with one's life, they may cause a difficulty in trusting the personal relevance of socially communicated information that challenges their rigid and impairing beliefs about the self, other and world–like the information presented in treatment (Fonagy, Luyten, Allison, & Campbell, 2017).

Alternatively, the association between the specific borderline factor and poorer prognosis may be a by-product of controlling for general PD, which reduced the initial depression scores and hence steepness of the slope. However, those with higher borderline factor scores were predicted to have higher end-point depression scores than those with low borderline factor scores, suggesting that the flatter slope is not purely a function of removing the baseline severity effect. Still, we caution any definitive interpretation of these findings

given that the specific borderline factor's reliability was relatively weak, and the significance of its prediction did not survive correction for demographic variables at a 5% alpha level.

Higher specific antisocial factor scores in the bifactor growth model were associated with lower initial depression scores and stronger quadratic (i.e. U-shaped) slopes. That is, once the effect of general PD and the other specific PD factors was controlled for, antisocial features (i.e. Disinhibition; see Supplement 1) predicted an initial decline followed by an upward inflection in depression scores. Few have documented the prognostic value of ASPD on depression outcomes, but an early prospective study reported higher depression recurrence rates associated with ASPD (and BPD) compared to bipolar disorder (Perry, 1988). More generally, ASPD is associated with high rates of recidivism (Bonta, Blais, & Wilson, 2014). The specific mechanisms that predict recurrence in offending and depression severity are unlikely to be the same, but the broader mechanisms associated with antisocial features may contribute to both, such as disinhibition (Remster, 2014). Future studies that include measures of hypothesised treatments mechanisms are necessary to test these hypotheses.

Limitations

Using dichotomous criterion-counts to assess underlying PD dimensions lacks genuine dimensionality and may have artificially inflated the correlations among items, as they are designed to detect threshold levels of pathology at the cost of specificity. While this may question the substantive validity of the general PD factor, the specific borderline and antisocial factors are free from the general variance and hence common method effects. Still, our PD measure is limited to self-report ratings that do not capture the full nature of personality difficulties relative to a multi-informant approach (Carlson, Vasire, & Oltmanns, 2013). Furthermore, the PHQ-9 may be subject to self-report biases, insofar as patients diagnosed with a PD often rate their depression as more severe than do clinicians (Unger,

Hoffmann, Köhler, Mackert, & Fydrich, 2013). Therefore, the slower rate of decline associated with borderline features and the U-shaped pattern of change associated with antisocial features may be a function of stylistic patterns in *reporting* rather than behaving. Nonetheless, the two are unlikely to be distinct: negative response styles may in themselves reflect behavioural tendencies that confer risk to psychopathology (Lahey et al., 2012).

We did not sample the full range of personality disorders, particularly histrionic, schizoid, dependent, and paranoid PDs, due to their low occurrence. Therefore, we must be cautious in generalizing our findings as they might be limited to personality configurations found within a depression-seeking sample. However, the construct validity of these lower frequency PDs has been questioned due to their low rates of prevalence in the population and low symptom specificity (Skodol et al., 2011a). This is not to say that these PDs lack clinical utility; rather, they might be better thought of as capturing broader-level traits than specific PDs, as was proposed in the DSM-5 alternative model (American Psychiatric Association, 2013). Nonetheless, even the PDs sampled demonstrate a pattern of loadings consistent with the trait domains featured across the ICD-11 and DSM 5 alternative model of PD[3] (Bach et al., 2020; see Supplement 1). This highlights the densely hierarchical nature of PDs and we encourage researchers to assess multiple levels of functioning for a more comprehensive picture of personality disorder.

We have assumed that PDs are a primary feature of the clinical profile that shapes the course of depression (Tyrer, 2015). There is good evidence supporting this: PDs in adolescence significantly increase the risk of depression in adulthood (Johnson et al., 1999), and improvements in PD precede improvements in depression, but not the reverse (Gunderson et al., 2004). Nonetheless, the presence of both a PD and depression in adolescence often outweighs the predictive strength of either one alone (Crawford et al.,

2008; Kasen, Cohen, Skodol, Johnson, & Brook, 1999). Hence, the relationship between PDs and depression may not be a simple, unidirectional one (Livesley, 2015).

Furthermore, while we assume that borderline and antisocial features are static predictors of depression prognosis, personality traits are context- and mood-dependent (Hopwood, Zimmermann, Pincus, & Krueger, 2015; Wright, Hopwood, & Simms, 2015). Our baseline assessment of PD is limited to a certain context (e.g. an acute illness state) and does not capture personality dynamics in terms of variation in how people interact with their environments. We advise future researchers to take repeated measurements of PDs to investigate their reciprocal relationships with other problems, to ultimately inform on the mechanisms of change.

Implications

Our findings suggest that personality disorder assessment should include both shared and specific aspects of PDs. There is clear overlap in PD symptoms that in part reflects semantic redundancy, but also the overall degree of life impairment that patients experience (Livesley, 2011). The specific characteristics associated with PDs should not, however, be dismissed (or focused on exclusively, as is currently the case). Rather, a patient's overall level of severity as well as their stylistic expressions should be assessed (Hopwood et al., 2011). This 'binomial nomenclature' of PDs is already featured in the 11th revision of the International Classification of Diseases, where PD diagnosis is based on a single dimension that reflects the severity of personality impairment (ranging from mild to severe dysfunction), as well as five trait-domains (e.g., negative affectivity, detachment, disinhibition, dissociality, and anankastia) that specify the ways in which this impairment is expressed (Tyrer et al., 2015). There is also movement towards a binomial taxonomy in the DSM-5's alternative model of PDs (Skodol et al., 2011b). These two systems differ in several ways but share a

common ground in representing the general (severity) and specific (stylistic) components of personality disorders (Bach, Sellbom, Skjernov, & Simonsen, 2018).

We note that while borderline (and antisocial) factors uniquely predicted depression outcomes, this does not support the inclusion of a borderline PD qualifier in the diagnostic system–which is a topic of much debate (Reed, 2018)–because these factors reflect features or perhaps trait dimensions (i.e. Negative Affectivity and Disinhibition; see Supplement 1) that vary across the sample, rather than a 'borderline' subgroup of patients. In fact, while a borderline qualifier is consistent with current practice, the current findings suggest that it may be somewhat redundant, given that i) borderline items loaded preferentially onto the general PD factor, ii) the remaining items that loaded onto the specific borderline factor reflect Negative Affectivity (see Supplement 1), and iii) a 'borderline pattern' might be best captured by combinations of trait domains, such as high levels of Negative Affectivity and Disinhibition (Bach et al., 2020), the analogues of which (i.e. borderline and antisocial factors) predicted poorer outcomes in this study.

Our findings also highlight the importance of studying the unique contributions of the general and specific aspects of PDs to depression outcomes. If these components are not separated out, then their potentially conflicting relationships may obscure prognostic predictions. We used the bifactor model to achieve this, which is not without controversy (Sellbom & Tellegen, 2019; van Bork, Epskamp, Rhemtulla, Borsboom, & van der Maas, 2017; Watts et al., 2019). Nonetheless, we hope to have demonstrated that with proper theoretical justification (e.g., conceptualizing personality dysfunction in terms of shared and stylistic features), model evaluation beyond standard fit indices (e.g., information criteria and model-based reliability indices), and external validation (e.g., predicting future depression outcomes and comparing predictions with alternative models), the bifactor model can be meaningfully applied to assessment research. Future studies should investigate how general

and specific PD factors interact with different treatments in randomized controlled studies to better understand ‘what works for whom’ (for an example in the developmental psychopathology field, see Aitken et al., 2020).

We have shown that personality disorder symptoms are best described by a general factor that reflects the severity of individuals’ personality dysfunction, as well as specific factors that reflect stylistic expressions associated with different disorders. Borderline and antisocial features are associated with poorer prognosis throughout inpatient treatment for depression, once the variance associated with general personality disorder is controlled.

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Footnotes

[1]There is partial overlap between Sharp et al.'s (2015) sample and our own, but our analytic approaches differ. We used a confirmatory model to actively test the bifactor structure that Sharp et al. and others have reported using exploratory methods. Moreover, confirmatory models are more restrictive and less likely to overfit sample-specific variances than exploratory solutions (unless the model is markedly mis-specified).

[2]While borderline PD items formed a specific factor in our study, others have shown that borderline items load to unity with the general factor (Sharp et al., 2015; Williams et al., 2017; Wright et al., 2016). The reason for this disparity is unclear and may be a product of different methodological features (e.g., exploratory vs. confirmatory models).

[3]We thank the reviewer who pointed this out.

Table 1

Clinical and demographic characteristics of the inpatient sample (N = 2,352)

Sample Characteristic	*M* or *N*	*SD* or %
Clinical		
PHQ-9 (admission)	15	7
Minimal or none (0-4)	233	10%
Mild (5-9)	327	14%
Moderate (10-14)	455	18%
Moderate severe (15-19)	575	24%
Severe (20-27)	762	32%
Length of Stay (weeks)	6	3
Episode Number		
First admission	2055	87%
>1 admissions	297	13%
Program		
Hope	641	27%
CPAS	379	16%
Compass	758	32%
PIC	574	24%
Demographic		
Age	35	15
Sex		
Female	1120	48%
Male	1232	52%
Racial Background		
White or Caucasian	2096	89%
Other[a]	255	11%
Highest Level of Education		
Some schooling	56	2%
High School Diploma or Equivalent	211	9%
Some College	814	35%
Bachelors, Technical, or Associates Degree	761	33%
Postgraduate (Masters, Doctoral, or Professional Degree)	481	21%
Marital Status		
Married	1760	75%
Never married/separated	592	25%

Note. Compass = Compass Program for Young Adults (18-30); Hope = Hope Program for Adults; CPAS = Comprehensive Psychiatric Assessment Service; PIC = Professionals in Crisis program.

[a]Includes Asian, Black or African-American, Native American or Other Pacific Islander, and Multiracial.

Figure Captions

Figure 1. (A) The linear slope factor for general personality disorder scores +/- 2 standard deviations (SDs) from the mean; (B) The linear slope factor for specific borderline factor scores +/- 2 SDs from the mean; (C) The quadratic slope factor for specific antisocial factor scores +/- 2 SDs from the mean. The 'Overall' slope in each sub-figure reflects the linear or quadratic slope holding the general and specific factors constant. All growth factors are conditional on centred clinical and demographic covariates. Error bars reflect standard errors of the predicted means.

Supplement 1. Confirmatory Factor Analysis (CFA)

Method

We compared three item-level CFA models for how well they described the covariation among SCID-II PD symptoms. The first model included a single factor upon which all symptoms loaded. The second model included six correlated factors each representing a PD diagnosis with no cross-loadings. The third model included a general factor upon which all items loaded, as well as six specific factors that each represented a PD diagnosis. We tested two versions of the bifactor model: an orthogonal version where the specific factors were uncorrelated (Holzinger & Swineford, 1937), and an oblique version where the correlations among specific factors were freed. In both versions, the general and specific factors were uncorrelated.

Some authors have shown that the bifactor model's superiority over other models is partly due to its complexity and overfitting tendencies (Greene et al., 2019; Murray & Johnson, 2013; Reise, Kim, Mansolf, & Widaman, 2016). Therefore, models were estimated using the robust maximum-likelihood estimator (MLR) and compared using Akaike Information Criteria (AIC), Bayesian Information Criteria (BIC), and sample-size adjusted Bayesian Information Criteria (aBIC), which penalize for model complexity based on the number of freely estimated parameters. A difference of 2 (AIC/BIC/aBIC) between models was considered negligible; a difference of 2-7 (AIC) or 2-6 (BIC/aBIC) suggested some evidence favouring the competing model; a difference of 7-10 (AIC) or 6-10 (BIC/aBIC) suggested strong evidence favoring the competing model, and a difference greater than 10 (AIC/BIC/aBIC) suggested very strong evidence favouring the competing model (Raftery, 1995).

We also re-estimated models with the weighted least squares means and variances adjusted estimator to assess their global fit. Acceptable fit was defined by Comparative Fit Index (CFI) values ≥ .90, Tucker-Lewis Index (TLI) values ≥ .90, and root mean squared error of approximation (RMSEA) values ≤ .08, whilst excellent fit was indicated by CFI values ≥ .95, TLI ≥ .95 and RMSEA ≤ .06 (Hu & Bentler, 1999). All models were estimated in Mplus 8.0 (Muthén & Muthén, 2017).

A bifactor model might fit the data better than competing models, but this tells us little about the reliability of the general and specific factors (Sellbom & Tellegen, 2019). We therefore calculated model-based reliability indices for the bifactor model from the MLR factor loading matrix using Dueber's (2017) Bifactor Indices Calculator. Reliability indices included omega hierarchical and omega hierarchical subscale (ω_H/ω_{Hs}; the proportion of variance in raw total or subscale scores explained by a given factor, respectively), explained common variance and explained common variance-subscale (ECV/ECV_s; the proportion of variance in modelled total or subscale scores explained by a given factor, respectively), factor determinacy (FD; the reliability of factor scores), and construct replicability (H; the reliability of a factor given its indicators; Rodriguez, Reise, & Haviland, 2016). ω_H/ω_{Hs} and ECV/ECVs values ≥ .7 indicate that the majority of raw or modelled variance, respectively, is explained by a single factor (Rodriguez et al., 2016). FD values ≥ .9 (Gorsuch, 1983), and H values ≥ .7 (Hancock & Mueller, 2001), reflect reliable factor scores or factors, respectively.

Results

The single factor model fit the data poorly (see Table S1) but showed healthy positive loadings across symptom items, demonstrating their unidimensionality (see Table S2). The correlated factors model–with factors representing each PD–showed a good fit that improved on the single factor model (ΔAIC = 2,843; ΔBIC = 2,756; ΔaBIC = 2,804; see Table S1).

There were no signs of local strain and each factor showed healthy positive loadings (see Table S2). All factors were positively and uniformly correlated (aside from the antisocial factor), suggesting the presence of a higher-order factor (see Table S2).

The orthogonal bifactor model–with a general factor and uncorrelated specific factors representing each PD–showed a good fit that improved on the correlated factors model (ΔAIC = 443; ΔBIC = 247; ΔaBIC = 355; see Table S1). By contrast, the oblique bifactor model–with a general factor and correlated specific factors–did not converge, so we only interpret the orthogonal model. The bifactor solution was multidimensional, with the common variance split between the general PD factor (42%) and specific factors (58%), favouring the latter. However, the variance in raw total scores (e.g., overall PD symptomatology) was mostly explained by the general PD factor (ω_H = .79). The variance in raw subscale scores (i.e. specific PD scores) was also largely explained by the general PD factor rather than respective specific PD factor, except for the antisocial factor (ω_{Hs} = .74) and narcissistic factor (ω_{Hs} = .68). Most factors were adequately represented by their indicators, apart from the avoidant (*H* = .64) and borderline (*H* = .59) factors.

Table S2 shows the factor loadings for the orthogonal bifactor model. On average, narcissistic PD items loaded strongly on the specific narcissistic factor ($\overline{\lambda}$ = 0.63, *SD* = 0.19) and weakly on the general PD factor ($\overline{\lambda}$ = 0.37, *SD* = 0.13). Similarly, antisocial PD items loaded strongly on the specific antisocial factor ($\overline{\lambda}$ = 0.82, *SD* = 0.05) and moderately on the general PD factor ($\overline{\lambda}$ = 0.48, *SD* = 0.11). The specific borderline and avoidant factors explained the least amount of common variance (ECV_s = .04 and .05, respectively) and raw subscale variance (ω_{Hs} = .20 and .31, respectively), and showed weak and moderate factor loadings, respectively (borderline: $\overline{\lambda}$ = 0.32, *SD* = 0.17; avoidant: $\overline{\lambda}$ = 0.43, *SD* = 0.10), as well as the strongest general factor loadings (borderline: $\overline{\lambda}$ = 0.58, *SD* = 0.09; avoidant: $\overline{\lambda}$ =

0.59, *SD* = 0.08). Some schizotypal PD items loaded preferentially onto the specific schizotypy factor ($\overline{\lambda}$ = 0.54, *SD* = 0.32), while others loaded preferentially onto the general PD factor ($\overline{\lambda}$ = 0.43, *SD* = 0.20). Obsessive-compulsive PD items showed weak general PD factor loadings ($\overline{\lambda}$ = 0.36, *SD* = 0.10) and moderate obsessive-compulsive specific factor loadings ($\overline{\lambda}$ = 0.43, *SD* = 0.10).

Discussion

Consistent with past studies, we found that a bifactor model with general and specific PD factors described the covariation among PD symptoms best (Conway et al., 2016; Jahng et al., 2011; Sharp et al., 2015[1]; Williams et al., 2017; Wright et al., 2016). We also found that borderline PD items loaded most strongly onto the general PD factor rather than the specific borderline factor (Conway et al., 2016; Sharp et al., 2015; Williams et al., 2017; Wright et al., 2016). This supports the idea that general PD reflects dysfunction in self-functioning (e.g., stability and coherence in one's sense of identity) and interpersonal functioning (e.g., the ability to relate to and empathise with others), which is consistent with Criterion A of the DSM-5 Section III alternative model of personality disorders (American Psychiatric Association, 2013). Avoidant personality disorder (PD) items also loaded preferentially onto the general PD factor rather than the specific avoidant factor, particularly items associated with self-impairment ('views self as inept') and interpersonal problems ('preoccupied with rejection').

By contrast, avoidant and narcissistic PD items loaded most strongly onto their respective specific factors, as has been reported by others (Sharp et al., 2015; Williams et al., 2017; Wright et al., 2016). This follows the general trend in psychopathology research, whereby antisocial and substance-related problems load preferentially onto externalizing factors rather than the general psychopathology factor (Caspi et al., 2014; Lahey et al., 2012).

It is important to note that while narcissistic PD items showed weak general factor loadings, antisocial PD items showed moderate general factor loadings. Therefore, it is not the case that all externalizing-type personality items are distinct from the general PD factor, but rather, some show reliable measurement beyond the general variance.

Schizotypal PD items were split between the general and specific schizotypal factors in a pattern mirroring prior item-level analyses (Sharp et al., 2015; Williams et al., 2017). For example, items associated with ideas of reference, suspiciousness, and social anxiety loaded more strongly onto the general PD factor (and showed some of the strongest general factor loadings among all items), whereas items associated with unusual perceptions, beliefs, and behaviours loaded more strongly onto the specific schizotypal factor. This pattern may be best understood as a divide between severity and style (Hopwood et al., 2011): paranoid thinking and anxiety accompany a range of severe presentations (Caspi et al., 2014), whereas odd beliefs and behaviours are characteristic of schizotypal personality traits that are not necessarily pathological (van Os & Reininghaus, 2016). Finally, obsessive-compulsive PD items showed weak-to-moderate loadings on both the general and specific obsessive-compulsive PD factor.

Upon a closer examination at the item level, items that loaded most strongly onto each specific PD factor resemble items that define the trait domains outlined in the ICD-11 and DSM 5 alternative models of PD. This is demonstrated in the table below using trait domain items from a large, multi-national study that replicated a six-factor trait structure in both patient and community samples (Bach et al., 2020). A six-factor trait structure is also consistent with recent developments in personality research (e.g., HEXACO model; Ashton & Lee, 2007). Our specific factors likely reflect trait domains–which is naturally the next level of analysis after controlling for general functioning–though we are lacking direct measures to validate this.

Table 1. Top Three Items Loading on Each Specific PD Factor in the Bifactor model (left) and Bach et al.'s (2020) Trait Domain Factors (right)

PD Item	Trait Domain Item
Antisocial	Disinhibition
Disregard for safety (λ = .89)	**Irresponsibility**
Irritable, aggressive (λ = .85)	**Impulsivity**
Failure to conform (λ = .86)	Distractibility
Avoidant	Detachment
Socially inhibited (λ = .62)	**Withdrawal**
Views self as inept (λ = .47)	Anhedonia
Must be liked (λ = .46)	**Intimacy Avoidance**
Borderline	Negative Affectivity
Affective instability (λ = .49)	**Emotional lability**
Interpersonal instability (λ = .48)	Anxiousness
Intense anger (λ = .46)	**Separation insecurity**
Narcissistic	Antagonism
Believes s/he is special (λ = .85)	**Manipulative**
Grandiose (λ = .81)	**Deceitfulness**
Exploitative (λ = .73)	**Grandiose**
Obsessive-compulsive	Anankastia
Workaholic (λ = .54)	**Perfectionism**
Orderly (λ = .52)	**Rigidity**
Reluctant to delegate (λ = .52)	**Orderliness**

Schizotypal	Psychoticism
Odd thinking/speech (λ = .90)	**Unusual beliefs**
Odd behavior/appearance (λ = .82)	**Eccentricity**
Odd beliefs + constricted affect (λ = .77)	**Perceptual dysregulation**

Note. There is not meant to be a one-to-one correspondence between each PD item and trait item. Trait items that overlap with at least one PD item within each problem area are in bold.

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Supplement 2. Latent Growth Models Using the Correlated PD Factors

Validity studies have been criticized for not comparing predictions of the bifactor model to other models (Watts, Poore, & Waldman, 2019). We therefore ran a supplementary analysis of the part and full conditional growth models using PD factors from the correlated factors model. The correlated factors model conflates the general and specific variance in PD measures and hence should mirror existing studies of PDs predicting depression outcomes. That is, correlated PD factors should mimic the predictive effect of general PD, predicting higher baseline depression scores but not differential rates of change. Controlling for general PD, or in this case its sequalae (e.g., baseline depression severity), will minimise the predictive effect of correlated PD factors on initial depression severity and changes over time.

We report unstandardized regression coefficients for PD factors predicting the intercept factor (b_0), linear slope factor (b_1), and quadratic slope factor (b_2). In the part conditional growth model with correlated PD factors (including antisocial, avoidant, borderline, narcissistic, obsessive-compulsive, and schizotypal PD factors) and clinical covariates, the schizotypal PD factor at admission predicted higher intercept scores (i.e. week 2 PHQ-9 scores; $b_0 = .80$, $z = 2.03$, $p = .043$, 95% CI [0.03, 1.57]) and steeper linear declines in PHQ-9 scores ($b_1 = -0.94$, $z = -2.14$, $p = .033$, 95% CI [-1.80, -0.08]). Higher borderline factor scores predicted stronger inverted U-shaped changes in PHQ-9 scores ($b_2 = -0.40$, $z = -2.48$, $p = .013$, 95% CI [-0.71, -0.08]), while higher antisocial factor scores predicted marginally stronger U-shaped changes ($b_2 = 0.25$, $z = 1.90$, $p = .058$, 95% CI [-0.01, 0.51]). Regression coefficients for the clinical covariates matched those in the full conditional growth model (see below).

In the full conditional model with correlated PD factors, clinical covariates, and demographic covariates, higher schizotypal PD factor scores continued to predict higher

intercept values (b_0 = .80, z = 2.03, p = .043, 95% CI [0.03, 1.58]) and steeper linear declines (b_1 = -0.98, z = -2.23, p = .026, 95% CI [-1.83, -0.12]). Moreover, higher borderline scores continued to predict stronger inverted U-shaped quadratic growth (b_2 = -0.36, z = -2.25, p = .024, 95% CI [-0.68, -0.05]), while higher antisocial scores significantly predicted stronger U-shaped growth (b_2 = 0.26, z = 1.99, p = .046, 95% CI [0, 0.52]). Table S4 shows the regression coefficients for the remaining PD factors, clinical covariates, and demographic covariates.

For reference, we ran a growth model with correlated PD factors but without clinical and demographic covariates as the latter might be controlling for variance associated with general PD. All PD factors predicted the intercept factor. Specifically, higher intercept values were predicted by higher avoidant (b_0 = 0.92, z = 2.34, p = .019, 95% CI [0.15, 1.70]), borderline (b_0 = 1.85, z = 3.44, p < .001, 95% CI [0.79, 2.90]) obsessive-compulsive (b_0 = 0.65, z = 1.57, p = .116, 95% CI [-0.16, 1.46]) and schizotypal scores (b_0 = 0.85, z = 1.44, p = .150, 95% CI [-0.05, 0.35]), though the latter two predictions are marginal at best. By contrast, lower intercept values were predicted by higher antisocial (b_0 = -1.25, z = 2.29, p = .022, 95% CI [-2.33, -0.18]) and narcissistic (b_0 = -1.10, z = 2.16, p = .031, 95% CI [-2.09, -0.10]) scores. No PD factor predicted variation in the linear slope factor, but the borderline factor predicted stronger inverted U-shaped changes in PHQ-9 scores (b_2 = -0.37, z = 2.34, p = .019, 95% CI [-0.67, -0.06]) and the antisocial factor marginally predicted stronger U-shaped changes (b_2 = 0.21, z = 1.63, p = .103, 95% CI [-0.05, 0.46]).

Comparing these growth models demonstrates how general severity can obscure the predictive effects of specific PDs on depression outcomes. For instance, in the final growth model reported with correlated PD factors alone, most factors predicted higher initial depression scores and no factors predicted linear changes in depression severity, mirroring

the general PD factor in the bifactor growth model. It would thus appear that the predictive effects of the correlated PD factors were influenced by the general variance. The only factors that predicted lower initial depression scores were the antisocial and narcissistic factors, which also showed the greatest reliability beyond the general variance in the bifactor model (see Table S2).

By contrast, most of the predictive effects of the correlated PD factors on initial depression scores disappeared in the part and full conditional growth models that controlled for depression severity at admission. In other words, the confounding effect of general PD appeared to be negated after controlling for an index of general severity (e.g., baseline severity), giving the impression that PDs do not predict variation in depression outcomes. An exception to this was the schizotypal factor, which predicted higher initial depression scores and steeper linear declines, but this might reflect a baseline severity effect or regression to the mean.

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Supplementary Table 1.

Model fit values for the CFA models of the SCID-II Screening Questionnaire

Model	Fit Estimate							
	χ^2	*df*	CFI	TLI	RMSEA	AIC	BIC	aBIC
Single Factor	5670	1127	.79	.78	.04	68,846	69,410	69,099
Correlated Factors	2992	1112	.91	.91	.03	66,003	66,654	66,295
Bifactor (orthogonal)	2661	1078	.93	.92	.03	65,560	66,407	65,940
Bifactor (oblique)	No convergence							

Note. χ^2 = chi-square statistic; aBIC = sample size adjusted Bayesian information criterion; CFI = Comparative Fit Index; *df* = degrees of freedom; TLI = Tucker-Lewis Index; RMSEA = Root Mean Square Error of Approximation.

Supplementary Table 2.

Standardized factor loadings for the single factor, correlated factor, and bifactor models of the SCID-II Screening Questionnaire

		Correlated Factors						Bifactor (orthogonal)						
SCID-II Item	Single	AS	AV	BL	NS	OC	ST	G_{PD}	AS	AV	BL	NS	OC	ST
Antisocial														
Failure to conform	.86***	.97***						.46***	.85***					
Deceitfulness	.93***	.94***						.61***	.74***					
Impulsivity	.94***	.98***						.58***	.80***					
Irritable, aggressive	.83***	.91***						.32***	.86***					
Disregard for safety	.84***	.96***						.38***	.89***					
Irresponsible	.92***	.94***						.53***	.78***					
Lacks remorse	.91***	.94***						.45***	.83***					
Avoidant														
Avoids social work	.58***		.70***					.57***		.39***				
Must be liked	.62***		.75***					.58***		.46***				
Restraint in intimacy	.54***		.61***					.51***		.31***				
Preoccupied with rejection	.69***		.81***					.73***		.34***				
Socially inhibited	.60***		.81***					.59***		.62***				
Views self as inept	.63***		.80***					.65***		.47***				
No risks or new activities	.53***		.66***					.52***		.41***				
Borderline														
Avoids abandonment	.58***			.66***				.55***			.41***			
Interpersonal instability	.52***			.62***				.49***			.48***			
Identity disturbance	.64***			.69***				.68***			.14*			
Self-harming impulsivity	.59***			.60***				.51***			.34***			
Suicidality	.53***			.60***				.48***			.38***			

Affective instability	.67***		.78***			.64***		.49***		
Empty	.66***		.70***			.73***		.07		
Intense anger	.60***		.64***			.50***		.46***		
Transient dissociation	.59***		.59***			.62***		.07		
Narcissistic										
Grandiose	.50***		.81***			.23***		.81***		
Preoccupied with fantasies	.56***		.67***			.41***		.52***		
Believes s/he is special	.44***		.79***			.14*		.85***		
Needs admiration	.55***		.72***			.52***		.50***		
Entitlement	.54***		.80***			.36***		.72***		
Exploitative	.58***		.80***			.33***		.73***		
Lacks empathy	.60***		.70***			.41***		.56***		
Envious	.56***		.58***			.58***		.25***		
Arrogant	.53***		.79***			.36***		.72***		
Obsessive-compulsive										
Orderly	.41***			.61***		.37***			.52***	
Perfectionistic	.44***			.61***		.46***			.40***	
Workaholic	.22***			.46***		.20***			.54***	
Moral inflexibility	.35***			.52***		.31***			.44***	
Hoarding	.35***			.46***		.34***			.31***	
Reluctant to delegate	.49***			.73***		.49***			.52***	
Miserly	.28***			.48***		.25***			.46***	
Rigidity	.45***			.56***		.43***			.28***	
Schizotypal										
Ideas of reference	.62***				.71***	.67***				.22***
Odd beliefs	.55***				.81***	.41***				.77***
Odd perceptions	.55***				.81***	.45***				.73***
Odd thinking/speech	.40***				.82***	.16*				.90***

Suspicious	.68***						.78***	.63***						.44***
Constricted affect	.59***						.85***	.37**						.77***
Odd behavior/appearance	.35**						.74***	.13						.82***
Lacks close friends	.41***						.44***	.42***						.10
Social anxiety	.65***						.62***	.66***						.13
Mean	.58	.95	.73	.65	.74	.55	.73	.46	.82	.43	.32	.63	.43	.54
SD	.16	.02	.08	.06	.08	.09	.13	.15	.05	.10	.17	.19	.10	.32
Inter-factor correlations														
		AS	AV	BL	NS	OC	ST							
	AS	—												
	AV	.27***	—											
	BL	.49***	.70***	—										
	NS	.57***	.40***	.61***	—									
	OC	.27***	.59***	.60***	.53***	—								
	ST	.36***	.61***	.69***	.51***	.47***	—							
Model-based Reliability														
ECV/ECV_s								.42	.17	.05	.04	.14	.06	.12
ω/ω_s								.97	.99	.89	.88	.92	.79	.92
ω_H/ω_{Hs}								.79	.74	.31	.20	.68	.47	.56
Relative Omega								.81	.75	.34	.23	.74	.60	.61
H-index								.95	.94	.64	.59	.90	.67	.91
FD								.96	.98	.84	.79	.95	.83	.96

Note. AS = Antisocial; AV = Avoidant; BL = Borderline; ECV/ECV_s = Expected Common Variance/Expected Common Variance-Subscale; FD = Factor Determinacy; G_{PD} = General personality disorder; NS = Narcissistic; OC = Obsessive-compulsive; ω/ω_s = Omega/Omega-subscale; ω_H/ω_{Hs} = Omega hierarchical/Omega hierarchical-subscale; ST = Schizotypal.

*$p < .05$

**$p < .01$

***$p < .001$

Supplementary Table 3.

Standardized and unstandardized growth factor and regression coefficients for the bifactor PD factors, clinical covariates, and demographic covariates predicting the intercept, linear slope, and quadratic slope factors

Variable	Estimate			
	Unstandardized (95% CI)	Standardized (95% CI)	*z*	*p*
Intercept				
Mean (η_0)	**9.31 (9.09, 9.53)**	**1.64 (1.58, 1.70)**	**82.8**	**< .001**
Variance (ζ_0)	**13.95 (12.38, 15.51)**	**0.43 (0.39, 0.48)**	**17.44**	**< .001**
PD Factor (b_0)				
General	**1.14 (0.79, 1.49)**	**0.20 (0.14, 0.26)**	**6.36**	**< .001**
Antisocial	**-0.51 (-1.02, -0.01)**	**-0.09 (-0.18, 0)**	**-1.99**	**0.047**
Avoidant	-0.32 (-0.75, 0.12)	-0.06 (-0.13, 0.02)	-1.43	0.153
Borderline	**-0.64 (-1.14, -0.13)**	**-0.11 (-0.20, -0.02)**	**-2.47**	**0.013**
Narcissistic	-0.27 (-0.65, 0.12)	-0.05 (-0.12, 0.02)	-1.35	0.176
Obsessional	-0.28 (-0.7, 0.14)	-0.05 (-0.12, 0.02)	-1.32	0.186
Schizotypal	0.27 (-0.24, 0.78)	0.05 (-0.04, 0.14)	1.02	0.306
Clinical (b_0)				
PHQ-9 Baseline	**0.51 (0.47, 0.54)**	**0.64 (0.60, 0.68)**	**28.13**	**< .001**
Length of stay	**0.05 (0.04, 0.06)**	**0.19 (0.14, 0.24)**	**7.69**	**< .001**
Episode Number	**1.45 (0.77, 2.13)**	**0.09 (0.04, 0.13)**	**4.16**	**< .001**
Unit (Hope v Compass)	-0.33 (-1.04, 0.38)	-0.03 (-0.08, 0.03)	-0.91	0.365
Unit (CPAS v Compass)	0.62 (-0.19, 1.43)	0.04 (-0.01, 0.09)	1.51	0.132
Unit (PIC v Compass)	-0.32 (-1.16, 0.53)	-0.02 (-0.09, 0.04)	-0.73	0.463
Demographic (b_0)				
Sex	**-0.96 (-1.43, -0.48)**	**-0.08 (-0.13, -0.04)**	**-3.92**	**< .001**
Age	-0.01 (-0.03, 0.01)	-0.03 (-0.09, 0.03)	-0.88	0.381
Ethnic group	-0.55 (-1.25, 0.15)	-0.03 (-0.07, 0.01)	-1.53	0.125
Education	-0.20 (-0.74, 0.34)	-0.02 (-0.07, 0.03)	-0.73	0.466
Marital Status	0.20 (-0.42, 0.82)	0.02 (-0.03, 0.07)	0.64	0.524

Linear Slope				
Mean (η_1)	**-2.40 (-2.80, -2.01)**	**-0.72 (-0.90, -0.54)**	**-11.93**	**< .001**
Variance (ζ_1)	**8.39 (4.84, 11.93)**	**0.76 (0.61, 0.90)**	**4.64**	**< .001**
PD Factor (b_1)				
General	-0.22 (-0.66, 0.23)	-0.07 (-0.20, 0.07)	-0.96	0.340
Antisocial	-0.17 (-0.83, 0.49)	-0.05 (-0.25, 0.15)	-0.50	0.620
Avoidant	0.17 (-0.35, 0.69)	0.05 (-0.10, 0.21)	0.64	0.522
Borderline	**0.52 (-0.06, 1.11)**	**0.16 (-0.01, 0.33)**	**1.75**	**0.080†**
Narcissistic	0.14 (-0.35, 0.63)	0.04 (-0.10, 0.19)	0.55	0.580
Obsessional	0.38 (-0.11, 0.88)	0.12 (-0.03, 0.26)	1.51	0.131
Schizotypal	-0.55 (-1.19, 0.10)	-0.16 (-0.36, 0.03)	-1.59	0.111
Clinical (b_1)				
PHQ-9 Baseline	**-0.12 (-0.17, -0.07)**	**-0.26 (-0.37, -0.15)**	**-4.90**	**< .001**
Length of stay	**0.04 (0.02, 0.06)**	**0.24 (0.12, 0.36)**	**4**	**< .001**
Episode Number	-0.18 (-1.13, 0.78)	-0.02 (-0.11, 0.08)	-0.36	0.719
Unit (Hope v Compass)	0.59 (-0.31, 1.49)	0.08 (-0.04, 0.20)	1.28	0.199
Unit (CPAS v Compass)	**2.57 (0.72, 4.42)**	**0.29 (0.09, 0.49)**	**2.73**	**0.006**
Unit (PIC v Compass)	0.60 (-0.54, 1.75)	0.08 (-0.07, 0.22)	1.03	0.302
Demographic (b_1)				
Sex	-0.04 (-0.68, 0.60)	-0.01 (-0.10, 0.09)	-0.13	0.897
Age	**-0.04 (-0.07, -0.01)**	**-0.19 (-0.32, -0.05)**	**-2.58**	**0.010**
Ethnic group	0.31 (-0.67, 1.29)	0.03 (-0.06, 0.11)	0.62	0.533
Education	-0.24 (-0.97, 0.50)	-0.04 (-0.15, 0.08)	-0.62	0.532
Marital Status	-0.06 (-0.89, 0.77)	-0.01 (-0.12, 0.10)	-0.14	0.887
Quadratic Slope				
Mean (η_2)	**0.30 (0.13, 0.46)**	**0.27 (0.10, 0.44)**	**3.54**	**< .001**
Variance (ζ_2)	**0.99 (0.37, 1.61)**	**0.84 (0.66, 1.01)**	**3.13**	**0.002**
PD Factor (b_2)				
General	-0.06 (-0.21, 0.10)	-0.05 (-0.20, 0.09)	-0.72	0.472
Antisocial	**0.26 (0.04, 0.47)**	**0.24 (0.03, 0.45)**	**2.36**	**0.018**
Avoidant	0.07 (-0.11, 0.24)	0.06 (-0.10, 0.22)	0.77	0.441

Borderline	-0.11 (-0.31, 0.09)	-0.10 (-0.28, 0.08)	-1.08	0.278
Narcissistic	0.01 (-0.17, 0.19)	0.01 (-0.16, 0.18)	0.09	0.930
Obsessional	-0.04 (-0.22, 0.14)	-0.03 (-0.20, 0.13)	-0.41	0.681
Schizotypal	0.15 (-0.08, 0.39)	0.14 (-0.08, 0.36)	1.29	0.199
Clinical (b_2)				
PHQ-9 Baseline	0.01 (-0.01, 0.03)	0.07 (-0.04, 0.19)	1.21	0.226
Length of stay	**-0.01 (-0.02, 0)**	**-0.17 (-0.30, -0.03)**	**-2.42**	**0.016**
Episode Number	0.17 (-0.15, 0.50)	0.05 (-0.05, 0.16)	1.04	0.301
Unit (Hope v Compass)	-0.15 (-0.46, 0.17)	-0.06 (-0.19, 0.07)	-0.92	0.360
Unit (CPAS v Compass)	**-0.62 (-1.31, 0.07)**	**-0.21 (-0.45, 0.03)**	**-1.75**	**0.080†**
Unit (PIC v Compass)	-0.11 (-0.53, 0.31)	-0.04 (-0.21, 0.12)	-0.51	0.609
Demographic (b_2)				
Sex	0.04 (-0.19, 0.27)	0.02 (-0.09, 0.12)	0.33	0.743
Age	**0.01 (0, 0.02)**	**0.13 (-0.03, 0.28)**	**1.68**	**0.093†**
Ethnic group	-0.10 (-0.45, 0.25)	-0.03 (-0.12, 0.07)	-0.55	0.583
Education	0.16 (-0.11, 0.42)	0.07 (-0.05, 0.19)	1.17	0.240
Marital Status	0.06 (-0.24, 0.36)	0.02 (-0.10, 0.15)	0.38	0.704

Note. PD = personality disorder; PHQ-9 = Patient Health Questionnaire. Significant coefficients are in bold.

†Marginal result ($p < .1$)

Supplementary Table 4.

Standardized and unstandardized growth factor and regression coefficients for the correlated PD factors, clinical covariates, and demographic covariates predicting the intercept, linear slope, and quadratic slope factors

Variable	Estimate			
	b (95% CI)	*B* (95% CI)	*z*	*P*
Intercept				
Mean (η_0)	**9.30 (9.08, 9.53)**	**1.64 (1.58, 1.71)**	**82.69**	**< .001**
Variance (ζ_0)	**14.29 (12.87, 15.71)**	**0.45 (0.40, 0.49)**	**19.73**	**< .001**
PD Factor (b_0)				
Antisocial	-0.56 (-1.29, 0.17)	-0.1 (-0.23, 0.03)	-1.50	0.135
Avoidant	0.08 (-0.51, 0.67)	0.01 (-0.09, 0.12)	0.27	0.79
Borderline	0.38 (-0.38, 1.15)	0.07 (-0.07, 0.2)	0.98	0.328
Narcissistic	-0.03 (-0.68, 0.62)	-0.01 (-0.12, 0.11)	-0.10	0.924
Obsessional	0.06 (-0.54, 0.66)	0.01 (-0.09, 0.12)	0.21	0.834
Schizotypal	**0.80 (0.03, 1.58)**	**0.14 (0.01, 0.28)**	**2.03**	**0.043**
Clinical (b_0)				
PHQ-9 Baseline	**0.52 (0.48, 0.55)**	**0.66 (0.62, 0.69)**	**29.32**	**< .001**
Length of stay	**0.05 (0.04, 0.06)**	**0.19 (0.14, 0.24)**	**7.72**	**< .001**
Episode Number	**1.47 (0.78, 2.15)**	**0.09 (0.05, 0.13)**	**4.18**	**< .001**
Unit (Hope v Compass)	-0.35 (-1.06, 0.37)	-0.03 (-0.08, 0.03)	-0.95	0.342
Unit (CPAS v Compass)	0.57 (-0.24, 1.37)	0.04 (-0.01, 0.09)	1.37	0.170
Unit (PIC v Compass)	-0.48 (-1.32, 0.36)	-0.04 (-0.1, 0.03)	-1.13	0.260
Demographic (b_0)				
Sex	**-0.87 (-1.34, -0.39)**	**-0.08 (-0.12, -0.03)**	**-3.55**	**< .001**
Age	-0.01 (-0.03, 0.01)	-0.03 (-0.09, 0.04)	-0.77	0.439
Ethnic group	-0.57 (-1.28, 0.13)	-0.03 (-0.07, 0.01)	-1.58	0.113
Education	-0.19 (-0.73, 0.35)	-0.02 (-0.06, 0.03)	-0.69	0.490
Marital Status	0.23 (-0.39, 0.85)	0.02 (-0.03, 0.07)	0.72	0.471

Linear Slope				
Mean (η_1)	**-2.39 (-2.79, -2)**	**-0.74 (-0.93, -0.55)**	**-11.82**	**< .001**
Variance (ζ_1)	**8.17 (4.69, 11.64)**	**0.77 (0.63, 0.91)**	**4.61**	**< .001**
PD Factor (b_1)				
Antisocial	-0.06 (-0.86, 0.75)	-0.02 (-0.26, 0.23)	-0.13	0.894
Avoidant	-0.07 (-0.74, 0.59)	-0.02 (-0.23, 0.18)	-0.22	0.828
Borderline	0.58 (-0.34, 1.50)	0.18 (-0.11, 0.46)	1.23	0.219
Narcissistic	0.08 (-0.68, 0.83)	0.02 (-0.21, 0.26)	0.19	0.846
Obsessional	0.27 (-0.38, 0.92)	0.08 (-0.12, 0.28)	0.81	0.417
Schizotypal	**-0.98 (-1.83, -0.12)**	**-0.30 (-0.56, -0.04)**	**-2.23**	**0.026**
Clinical (b_1)				
PHQ-9 Baseline	**-0.13 (-0.17, -0.08)**	**-0.28 (-0.38, -0.17)**	**-5.16**	**< .001**
Length of stay	**0.04 (0.02, 0.06)**	**0.25 (0.13, 0.37)**	**3.95**	**< .001**
Episode Number	-0.17 (-1.13, 0.79)	-0.02 (-0.12, 0.08)	-0.35	0.728
Unit (Hope v Compass)	0.58 (-0.32, 1.48)	0.08 (-0.04, 0.20)	1.27	0.203
Unit (CPAS v Compass)	**2.60 (0.75, 4.45)**	**0.30 (0.09, 0.51)**	**2.75**	**0.006**
Unit (PIC v Compass)	0.71 (-0.43, 1.84)	0.09 (-0.06, 0.24)	1.22	0.225
Demographic (b_1)				
Sex	-0.09 (-0.73, 0.55)	-0.01 (-0.11, 0.08)	-0.28	0.782
Age	**-0.04 (-0.07, -0.01)**	**-0.19 (-0.33, -0.05)**	**-2.61**	**0.009**
Ethnic group	0.30 (-0.67, 1.27)	0.03 (-0.06, 0.12)	0.60	0.548
Education	-0.24 (-0.97, 0.50)	-0.04 (-0.15, 0.08)	-0.63	0.526
Marital Status	-0.08 (-0.91, 0.76)	-0.01 (-0.12, 0.10)	-0.18	0.858
Quadratic Slope				
Mean (η_2)	**0.29 (0.13, 0.45)**	**0.26 (0.10, 0.43)**	**3.48**	**0.001**
Variance (ζ_2)	**1.04 (0.44, 1.65)**	**0.87 (0.72, 1.01)**	**3.36**	**0.001**
PD Factor (b_2)				
Antisocial	**0.26 (0, 0.52)**	**0.24 (-0.01, 0.49)**	**1.99**	**0.046**
Avoidant	0.12 (-0.11, 0.35)	0.11 (-0.10, 0.31)	1.04	0.299
Borderline	**-0.36 (-0.68, -0.05)**	**-0.33 (-0.64, -0.03)**	**-2.25**	**0.024**
Narcissistic	-0.07 (-0.36, 0.22)	-0.06 (-0.33, 0.20)	-0.47	0.638

Obsessional	-0.04 (-0.27, 0.2)	-0.04 (-0.25, 0.18)	-0.32	0.750
Schizotypal	0.19 (-0.12, 0.50)	0.17 (-0.12, 0.46)	1.18	0.237
Clinical (b_2)				
PHQ-9 Baseline	0.01 (-0.01, 0.03)	0.07 (-0.04, 0.18)	1.19	0.236
Length of stay	**-0.01 (-0.02, 0)**	**-0.16 (-0.29, -0.02)**	**-2.33**	**0.02**
Episode Number	0.16 (-0.17, 0.49)	0.05 (-0.05, 0.15)	0.96	0.336
Unit (Hope v Compass)	-0.14 (-0.46, 0.17)	-0.06 (-0.18, 0.07)	-0.87	0.382
Unit (CPAS v Compass)	**-0.62 (-1.31, 0.06)**	**-0.21 (-0.45, 0.02)**	**-1.78**	**0.075**†
Unit (PIC v Compass)	-0.12 (-0.54, 0.29)	-0.05 (-0.21, 0.11)	-0.58	0.561
Demographic (b_2)				
Sex	0.05 (-0.18, 0.28)	0.02 (-0.08, 0.13)	0.42	0.671
Age	**0.01 (0, 0.02)**	**0.13 (-0.02, 0.28)**	**1.72**	**0.085**†
Ethnic group	-0.09 (-0.44, 0.26)	-0.02 (-0.12, 0.07)	-0.50	0.616
Education	0.16 (-0.11, 0.42)	0.07 (-0.05, 0.19)	1.16	0.246
Marital Status	0.06 (-0.24, 0.36)	0.02 (-0.10, 0.15)	0.38	0.703

Note. PD = personality disorder; PHQ-9 = Patient Health Questionnaire. Significant coefficients are in bold.
†Marginal result ($p < .1$)