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Journal

Journal of Psychopathology and Clinical Science, 127(6)

ISSN

2769-7541

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Publication Date

2018-08-01

DOI

10.1037/abn0000364

Peer reviewed

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Stable and Dynamic Elements of Borderline Personality Disorder over Ten Years in Adult Psychiatric Patients

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Disclosures: All authors have no conflicts of interest to report.

Abstract

Borderline personality disorder (PD) has historically been cast as an unabating condition. Longitudinal data, however, support a more variable time course marked by remission and relapse. In the present study, we tested the possibility that borderline PD has both stable (i.e., consistently present across time and situation, as modern diagnostic systems stipulate) and dynamic (i.e., episodic and situational) elements. Participants were 668 patients from the Collaborative Longitudinal Personality Disorders Study who were administered semistructured diagnostic interviews 5 times over a decade. Trait-state-occasion modeling dissected borderline pathology into time-invariant (i.e., trait) and time-varying (i.e., situational) components. Contradicting traditional views of PD intransigence, less than half of borderline PD variability (approximately 45%) was time-invariant (i.e., perfectly stable) over the study timeframe. Further, we found that the time-invariant component of borderline pathology, which we termed *borderline proneness*, was very closely related (r = .81) to a previously-validated Five Factor Model trait composite of borderline features. Moreover, the trait versus situational components showed a clear pattern of discriminant validity in relation to several putative causal agents for borderline PD (i.e., environmental pathogens, temperament dimensions). We conclude that borderline pathology contains a stable core *and* sizeable situational components, and that both elements relate systematically to normative personality dimensions and known risk factors. These findings have key implications for etiological research, prognosis, and treatment for borderline PD.

Keywords: borderline personality disorder; hybrid model; longitudinal structure; trait-state-occasion model

General Scientific Summary

According to conventional wisdom, borderline personality disorder (PD) is an intractable condition. From following adult patients for a decade, we found that the perfectly stable core of borderline PD was smaller than expected, explaining less than half of individual differences in disorder severity at any moment. Further, this fixed “borderline proneness” was robustly associated with personality traits (e.g., neuroticism) and environmental pathogens (e.g., child abuse) thought to underlie borderline PD.

Ten Years in Adult Psychiatric Patients

Borderline personality disorder (PD) traditionally has been considered a stable condition. Like other PDs, it has been theorized to onset early in development and to follow a generally unremitting course (American Psychiatric Association, 2013). Consistent with this conceptualization, targeted intervention often fails to immediately deflect the trajectory of borderline PD, leading to its reputation among practitioners as an intractable disorder (Lieb, Zanarini, Schmahl, Linehan, & Bohus, 2004).

Recent longitudinal data, however, refute conventional assumptions of borderline PD chronicity. In the Collaborative Longitudinal Personality Disorders Study (CLPS), borderline PD remitted in 85% of cases over 10 years of follow-up, albeit without much corresponding improvement in psychosocial functioning (e.g., social and occupational difficulty) (Gunderson, Stout et al., 2011). Likewise, in the McLean Study of Adult Development (MSAD), 93% of inpatients diagnosed with borderline PD achieved symptomatic remission over a 10-year period (Zanarini, Frankenburg, Reich, & Fitzmaurice, 2010). Of this remitted group, 30% had a symptomatic recurrence during the study timeframe. Separate CLPS investigations show that borderline PD is associated with greater personality trait instability (i.e., greater absolute change and re-ordering of individual differences over time) than other PDs (Hopwood et al., 2009). Collectively, these data suggest that the borderline PD diagnosis may be more variable than historically believed.

A Hybrid Model of Borderline Personality

Asking whether a construct like borderline PD is stable or not may be the wrong question. Several theories suggest that personality pathology in general and borderline PD in particular can be characterized by a *hybrid model*[1] consisting of distinguishable stable and dynamic elements (e.g., Clark, 2009; Gunderson, Stout et al., 2011; Hopwood, 2011; McGlashan et al., 2005; Morey

et al., 2007; Wright, 2011; Zanarini et al., 2007). Despite its popularity, this model rarely has been tested directly, and prior results are mixed. Reports from the CLPS and MSAD showed that borderline PD symptoms remitted at varying rates; some were clearly episodic, whereas others persisted for the full study interval (McGlashan et al., 2005; Zanarini et al., 2007). However, over a longer follow-up period no evidence was found for differential remission rates among borderline PD diagnostic criteria (Gunderson et al., 2011).

The hybrid model has also been tested from the perspective of differential (or rank-order), as compared to mean-level (or absolute), stability. Differential stability, reflected in retest correlations, signifies the degree to which the pattern of individual differences on some phenotype is fixed over time. Although putatively temperamental and acute symptoms were associated with distinct personality trait profiles, they did not differ with respect to retest correlations over 2-year intervals in the MSAD (Hopwood, Donnellan, & Zanarini, 2010). Thus, despite some prior evidence for varying rates of mean-level change over time across borderline PD symptoms, the rank-ordering of individuals over time may be similar for “temperamental” and “acute” features.

In summary, while theory points to the possibility that there may be both differentially stable (“trait-like”) and dynamic (“state-like”) elements of borderline PD over relatively long periods of time, previous research has not identified the relative proportion of stable and dynamic aspects of borderline PD in a longitudinal context.

Using Trait-State-Occasion Modeling to Distinguish Stable and Dynamic Elements of Borderline Personality Disorder

Trait-state-occasion (TSO) modeling is a confirmatory factor analytic technique that parses psychological constructs into *trait* (i.e., time-invariant) and *occasion* (i.e., time-varying) dimensions (for reviews, see Cole, 2006; Cole, Martin, & Steiger, 2005). The TSO model first derives a *state* factor that reflects the shared variance among the manifest borderline PD indicators

—in this case, the 9 borderline PD diagnostic criteria—at each study wave. The state factor therefore describes individuals' standing on a borderline PD dimension at a given point in time. Each of the state factors is, in turn, a composite of time-invariant -varying processes. In other words, the expression of borderline PD at any moment is a combination of trait-like and state-like influences. Thus, in the statistical model, state factor variance is a function of a single trait factor and various time-specific occasion factors (see Figure 1 for a conceptual diagram) (see also Cole, 2005; Kenny & Zautra, 1995; Steyer & Schmitt, 1994).

This decomposition is analogous to how quantitative genetics studies (e.g., twin designs) can partition between-person variance in, say, depression into genetic and environmental factors. It is also comparable to the psychometric practice of extracting method factors that capture measurement-specific variation (e.g., interview versus behavioral assessments) across a set of factor indicators, as compared to the substantive factor(s) that reflects the psychological attribute of interest (e.g., Brown, 2015).

The trait factor is completely fixed over the study timeframe. It captures the reasons that part of each state factor is perfectly stable over time. The trait factor in this scenario reflects an unchanging core of borderline pathology—which we call *borderline proneness*—that confers chronic susceptibility to symptoms. This foundation likely represents a combination of genetic predispositions to borderline PD, longstanding personality characteristics, and unyielding social-environmental conditions (e.g., Distel et al., 2008; Gunderson, Zanarini et al., 2011). As the size of this factor increases, relative to the time-varying factor, borderline PD would be said to be a more stable and enduring syndrome.

The occasion factors, in contrast, represents the reasons that borderline PD state factors are not entirely constant over time. That is, they capture state variance that is not explained by borderline proneness. Occasion factors are time-specific influences on borderline PD that impinge

on people only at selected measurement occasions. These processes are situational in nature, and can reflect transitory biological (e.g., medication), social (e.g., change in housing), and psychological (e.g., manic episode) determinants of borderline PD. Although they are not fixed across the study timeframe, the occasion factors may be somewhat persistent over time, as in the case of a tumultuous romantic relationship lasting two years. Thus, in the TSO model, an autoregressive function connects contiguous occasion factors, allowing for the possibility that situational influences on borderline PD at time *t* can spill over into time *t+1*. In that way, the occasion factors account for continuity in adjacent state factors that is not explained by the trait factor (Ciesla, Cole, & Steiger, 2007; LaGrange & Cole, 2008).

In the current study, we examined the longitudinal structure of borderline PD over 10 years in the CLPS. As mentioned above, prior reports from CLPS show that most borderline PD diagnoses remit, and that symptoms are imperfectly correlated, over long intervals. These findings led to the conclusion that borderline pathology is not as unyielding as typically assumed. However, this research has yet to document, in terms readily interpretable by investigators and clinicians, the extent to which borderline PD acts as a trait versus a state in patient samples. Stated differently, the size of the fixed foundation of borderline PD—the trait-like influence of borderline proneness—remains unknown. Here, we used TSO modeling to dissect borderline PD into perfectly stable versus situational components. In effect we quantified, for the first time, the unremitting core of borderline PD.

Construct Validity of Borderline Proneness

Having parsed borderline PD into its stable and dynamic elements, we sought to test the hypothesis that the stable features of borderline PD, or borderline proneness, can be accounted for by levels of normative personality traits. A large body of evidence has linked borderline PD to Five Factor Model (FFM) personality trait dimensions involving low neuroticism, low

agreeableness, and high conscientiousness (e.g., Few et al., 2016; Wright et al., 2015) and related facets (DeShong, Lengel, Sauer-Zavala, O'Meara, & Mullins-Sweatt, 2015; Lynam & Widiger, 2001; Miller, Reynolds, & Pilkonis, 2004; Samuel & Widiger, 2008). Some studies have also examined the longitudinal associations between FFM traits and borderline PD. Using a bivariate latent curve modeling framework, Wright et al. (2015) found that FFM traits, and particularly neuroticism, could account for most of the reliable variation in borderline PD change trajectories across 10 years in the MSAD data. Using cross-lagged panel modeling, Warner et al. (2004) showed that changes in a profile of FFM facets hypothesized to distinguish borderline PD were related to subsequent changes in borderline PD symptoms, as assessed by diagnostic interview in the CLPS study. However, these studies did not distinguish relatively enduring and more dynamic elements of borderline PD. As such, no study has yet examined the degree to which FFM traits specifically relate to borderline proneness, as we do in the current report.

In the next phase of this initial construct validation process, we focused in on putative correlates of borderline PD that were hypothesized to relate preferentially to either the stable or dynamic processes. We anticipated that childhood maltreatment would predict elevated borderline PD features primarily through its influence on borderline proneness, as opposed to the state-like component of borderline pathology across waves (cf. Green et al., 2010; McLaughlin et al., 2010). Analogously, we expected that temperament dimensions—as assessed via the Schedule for Nonadaptive and Adaptive Personality (Clark, 1993)—would exert an influence on the stable, and not dynamic, borderline PD factor (Clark, 2005). In contrast, we theorized that interview-based global assessment of functioning (GAF) ratings would track more with acute fluctuations in symptom expression (i.e., occasion factors) rather than borderline proneness (cf. Wright, Hopwood, Morey, & Skodol, 2016). We intended for this set of analyses collectively to permit an evaluation of the discriminant validity of the time-invariant and -varying factors in our TSO model.

The Current Study

We hypothesized that the time-invariant (i.e., trait) and -varying (i.e., occasion) dimensions of borderline PD would not differ significantly in magnitude, which would suggest that borderline PD has a considerable stable core but also oscillates in severity according to environmental inputs. Also, we expected for the temperamental symptoms, as codified in early tests of the hybrid model (Zanarini et al., 2007), would exhibit a larger time-invariant component than the acute symptoms. We predicted that borderline proneness would exhibit moderate-to-strong correlations with Five-Factor Model domains found in previous research to be selectively related to borderline PD. Finally, we expected that childhood maltreatment and temperament dimensions—as assessed at study baseline—would be selectively associated with borderline proneness, whereas the theoretically more acute, situation-specific GAF ratings would relate specifically to the time-varying element of borderline PD.

Methods

The Collaborative Longitudinal Personality Disorders Study (CLPS) recruited a sample of 668 patients who were diagnosed with a PD and/or major depressive disorder and no PD at baseline. Participants were administered the Diagnostic Interview for DSM-IV Personality Disorders (DIPD-IV; Zanarini et al., 2006) to assess borderline PD at baseline and at 4 other waves across 10 years of follow-up. Interviewers prompted patients to report on symptoms experienced over the prior 2 years (i.e., since the last scheduled assessment wave). Inter-rater reliability of the baseline borderline PD diagnosis in a sub-sample of 27 cases observed by 84 pairs of raters was . 90; 10-day retest reliability in a sub-sample of 52 participants was .87 (Zanarini et al., 2000). Interviewers were masked to previous diagnostic data at retest and follow-up assessments. All patients provided written informed consent to the interviews, and procedures were approved by the

New York State Psychiatric Institute Institutional Review Board (#5495R). Retention rates across 2-, 4-, 6-, and 10-year follow-up waves were 82.0%, 82.8%, 78.1%, and 64.5%, respectively.

At each measurement occasion, patients also competed the Revised NEO Personality Inventory (NEO-PI-R; Costa & McCrae, 1992), a self-report questionnaire designed to assess the FFM traits: Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness. Further, the NEO-PI-R assesses six facet scales that compose each domain. The entire measure consists of 240 items that feature a five-point Likert-type scale. Internal consistency coefficients for the FFM domains across assessment waves in this sample were all acceptable, ranging from .88 to .92. Lynam and Widiger (2001) reported that experts indicated that the facets linked to borderline PD were Anxiousness, Angry Hostility, Depressiveness, Impulsiveness, Vulnerability (Neuroticism facets); Feelings and Actions (Openness); and, inversely, Deliberation (Conscientiousness).

Three instruments assessed at baseline were used to examine the validity of trait and state scores from the borderline PD TSO model. The first was the Revised Childhood Experiences Questionnaire (CEQ-R; Zanarini et al., 1989), a clinician-rated interview designed to assess negative childhood experiences thought to be relevant to borderline personality including neglect, abuse, and witnessing violence. Second was the Schedule for Nonadaptive and Adaptive Personality (SNAP; Clark, 1993), a multidimensional self-report personality measure. We focus here on the three normal range SNAP temperament scales: Negative Temperament, Positive Temperament, and Disinhibition. Finally, patients were rated by trained interviewers on the DSM-IV Global Assessment of Functioning (GAF) scale, a 100-point single item measure on which high scores indicate better overall functioning. All of these baseline measures have strong track records of reliability and validity in the CLPS and other investigations. Psychometric information is reported extensively in other publications (see Battle et al., 2004; Morey et al., 2012).

Statistical Analysis

Latent variable models were estimated in Mplus (version 7.11) using the WLSMV estimator (Muthén & Muthén, 1998-2014). All 9 borderline PD criteria—operationalized as 0 (absent), 1 (subthreshold), and 2 (threshold)—served as indicators of a latent borderline pathology trait at each wave. To evaluate model fit, we used the comparative fit index (CFI), the Tucker-Lewis index (TLI), the root mean square error of approximation (RMSEA), and the weighted root mean square residual (WRMR). Acceptable model fit was defined according to guidelines forwarded by Hu and Bentler (1999): RMSEA values close to 0.06 or below, CFI and TLI values close to .95 or above, and SRMR values close to .08 or below. Sample sizes across follow up waves were 668, 548, 553, 522, and 431. Missing data were accommodated using full information maximum likelihood, which assumes that data are missing at random, although it can produce robust estimates even when that assumption is violated (Widaman, 2006). Related, the correlation between baseline borderline PD symptom severity and attrition at each follow-up ranged from -.07 (year 4) to .03 (year 2) (median r = -.01).

Results

Longitudinal Measurement Models

We performed longitudinal confirmatory factor analyses (CFAs) to evaluate measurement invariance—a precondition of TSO modeling (e.g., Horn & McArdle, 1992)—of borderline PD across all study waves. First, we estimated a model in which the factor loadings of corresponding borderline PD indicators were allowed to vary across measurement wave. Then, in a model imposing weak measurement invariance, we constrained loadings of the same indicators to equality across time. In both models, cross-wave error covariances for the same indicator were freely estimated.

The unconstrained CFA fit the data well, $\chi^2(845) = 1{,}231.55$, $p < .001$; CFI = .98; TLI = .97; RMSEA = 0.03; WRMR = 1.02. Factor loadings were all strong (λ range: .58-.86) and statistically significant at a .001 alpha threshold. In the constrained model, the restrictions on factor loadings over time did not produce a significant decrement in model fit, $\chi^2_{diff}(32) = 44.49$, $p = .07$. We concluded that weak measurement invariance was present, and therefore proceeded with TSO modeling.

Trait-State-Occasion Model of Borderline Personality

Figure 1 illustrates how the TSO model was used to parse borderline PD variance into 1 stable (i.e., time-invariant) *trait* factor and 5 time-varying *occasion* factors. The trait factor reflects the stable core of borderline proneness that does not fluctuate over the follow-up interval, whereas the occasion factors represent causes of borderline PD that vary over time. Autoregressive pathways were specified between contiguous occasion factors to capture the continuity of time-varying contributions to borderline PD. The state factor variances were constrained to 0, reflecting the fact that borderline PD variation at any point in time was completely partitioned into stable and time-varying components. Following Cole et al.'s (2005) recommendations, we (i) constrained factor loadings of borderline PD indicators to equality over time; (ii) constrained the residual terms of the latter 4 occasion factors to equality; (iii) fixed the 4 autoregressive parameters to equality, except the last autoregressive path, which spanned a 4-year (as opposed to 2-year) interval; and (iv) allowed residual correlations among the identical borderline PD indicators across waves.

Table 1 presents the TSO model parameter estimates. The model offered a good fit to the data, $\chi^2(887) = 1{,}225.47$, $p < .001$; CFI = .98; TLI = .98; RMSEA = 0.02; WRMR = 1.12. The trait factor variance represented 43% to 45% of the total borderline PD variability across waves. This proportion was not constant across follow-up assessments because borderline PD variability changed over time. For instance, the trait factor contribution was largest at year 10 because model-

estimated variability in the borderline PD construct was smallest at that stage. Occasion factor variance was larger than 0 at all time points (*p*s < .001), and moderate continuity was observed across adjacent occasion factors (standardized coefficient range: .55-.59).[2]

We compared the size of the time-invariant and time-varying factors by computing a chi-square difference test of the ratios of time-invariant to total variance and time-varying to total variance using the *model test* command in Mplus. This test was not statistically significant, $\chi^2(1) = 0.81$, $p = .37$, thus providing no evidence of a difference in magnitude between the two longitudinal factors. Further, a test of whether the ratio of time-invariant to time-varying variance was different from unity was also non-significant, $\chi^2(1) = 1.06$, $p = .30$, indicating that the ratio was not significantly different from 50/50. [3]

A Hybrid Model of Borderline Personality Disorder Change

We compared the time-invariant components of putatively temperamental versus acute borderline PD criteria, as distinguished by Zanarini et al. (2007). The temperamental symptoms, which are theoretically more enduring, include impulsivity, unstable relationships, chronic emptiness, and intense anger. The theoretically acute symptoms include abandonment fears, suicidal behavior and self-harm, affective instability, identity disturbance, and stress-related paranoia. We estimated two separate TSO models in which the state factors were defined by either the 4 temperamental diagnostic criteria or the 5 acute diagnostic criteria. Table 2 presents model fit indices and parameter estimates for both models. The TSO model fit the temperamental symptom data well, and the percentage of trait variance (to total variance) ranged from 35-43% across waves. The corresponding analysis for the acute symptoms also produced acceptable model fit, and the ratio of trait to total variance in this model was 49-51%. Thus, the proportion of variance in borderline pathology that was stable across 10 years was decidedly not higher for putatively temperamental symptoms, relative to acute symptoms. These results fail to support that the hybrid

model proposed by Zanarini et al., who found that impulsivity, unstable relationships, chronic emptiness, and intense anger showed slower mean-level declines in the MSAD dataset than other diagnostic criteria. This hybrid model evidently does not extend to the differential stability (as opposed to mean-level, or absolute, stability) of borderline PD features.

Trait-State-Occasion Models of Big Five Traits

As a preliminary step toward estimating the association between the time-invariant factors for FFM domains and borderline PD, we tested the fit of TSO models for each FFM domain separately. There was evidence of longitudinal measurement invariance for all FFM traits (results available in the online supplement). All five TSO models had interpretable patterns of factor loadings and provided a good fit to the data. Tables S1-S5 in the online supplemental material report the fit indices and parameter estimates from the univariate TSOs for each FFM domain. The mean (across waves) proportion of variance accounted for by the time-invariant factors was 47.6%, 66.6%, 74.4%, 77.5%, and 86.1% for Neuroticism, Conscientiousness, Agreeableness, Extraversion, and Openness, respectively.

Next, we estimated bivariate TSO models for each combination of borderline PD and the FFM domains. This set of models allowed us to estimate the longitudinal correlations between the time-invariant and -varying factors of all pairs of constructs. Each of the bivariate models provided a good fit to the data (full results available upon request). The lower triangle of Table 3 displays the time-invariant factor correlations derived from these analyses. Borderline proneness was most closely linked to Neuroticism (r = .74) and most weakly associated with Openness (r = -.15). Correlations with the other FFM domains were more moderate (r range: -.34 to -.48). Also, the upper triangle of Table 3 presents the residual correlations, which were constrained to equality over follow-up, among the time-varying factors from each bivariate model. These values reflect the association among transient (i.e., not perfectly stable) influences on the personality constructs. The

pattern of FFM time-varying factor associations with borderline PD very closely mirrored the time-invariant factor correlation results. That is, the dynamic element of borderline PD was strongly related to the dynamic element of Neuroticism (r = .64); less robustly with Conscientiousness, Extraversion, and Agreeableness (r range: -.30 to -.32); and minimally with Openness (r = .22).

We repeated this process for the FFM composite of borderline PD that is defined by the Neuroticism, Openness, and Conscientiousness facets identified by Lynam & Widiger (2001). In testing the longitudinal measurement model for this construct, we found that, whereas the model fit acceptably overall, $\chi^2(678) = 1{,}373.42$, $p < .001$; CFI = .95; TLI = .94; RMSEA = 0.04; SRMR = 0.08, the two Openness facets had small factor loadings on the latent trait. The Feelings facet loading range was .10 to .13 (ps < .001) and the Actions loading range was -.20 to -.23 (ps < .001), suggesting they were not operating as indices of borderline trait vulnerability as expected. We therefore dropped these two indicators (cf. Warner et al., 2004), and the resulting measurement model fit improved, $\chi^2(355) = 728.86$, $p < .001$; CFI = .97; TLI = .96; RMSEA = 0.04; SRMR = 0.07. The univariate TSO model of this FFM composite fit the data acceptably, and revealed that 48% to 56% of variation was completely stable over time (see Table S6 for fit statistics and parameter estimates).

Finally, a bivariate TSO involving borderline PD (as reflected in DIPD-IV symptoms) and the FFM borderline trait composite was estimated to evaluate the correspondence of the disorder and trait constructs. This TSO fit the data adequately ($\chi^2(2{,}599) = 3760.86$, $p < .001$; CFI = .93; TLI = .92; RMSEA = 0.03; WRMR = 1.30) and revealed a time-invariant factor correlation of .81 ($p < .001$). The correlation between the time-varying factors of borderline PD and the FFM composite was smaller, yet still strong (r = .63, $p < .001$). Overall, these results suggest that the majority of between-person variation in borderline proneness—both the stable and dynamic components—can be accounted for by selected FFM traits.

Comparing the Criterion Validity of Stable versus Dynamic Factors

Table S7 presents the descriptive statistics for childhood maltreatment, temperament dimensions, and GAF ratings, all of which were assessed at study baseline. Of note, approximately two-thirds of patients reported a history of abuse, neglect, and witnessing violence during childhood, and the mean GAF rating at study baseline was 58. Table 4 presents the results from regressions linking the TSO trait and occasion factors to these sets of validators. The three maltreatment predictors had a mean (*y*-)standardized effect of .87 on the trait factor, as compared to a mean effect of .04 on the occasion factor. Stated differently, these results indicated that, across different forms of childhood adversity, those who reported some form of maltreatment were on average approximately nine-tenths of a standard deviation higher on borderline proneness than those who did not. This standardized effect was largest for abuse (1.04) and smallest for witnessing violence (.68).

SNAP Negative Temperament was highly significantly related to both components, but the completely standardized effect size for the trait component (.79) far eclipsed that for the state component (.31). In a similar fashion, Positive Temperament was significantly, albeit modestly, linked to the trait component (-.21) but was virtually unrelated to the state component (.01). Unexpectedly, this pattern was reversed for Disinhibition, such that the effect size for the time-invariant factor (.14) was not statistically significant and only half as large as that for the time-varying factor (.30).

Unlike the environmental and temperament correlates, GAF ratings provided no evidence of discriminant validity. The completely standardized effects for GAF were -.42 for the time-invariant factor and -.31 for the time-varying factor. Translated into the original GAF units—which, although defunct with the release of DSM-5, may be more interpretable for some clinicians

—this effect corresponds to an increase in .38 versus .28 standard units for the time-invariant and -varying factors, respectively, per 10 unit decrease in GAF rating.

Discussion

Extending prior CLPS research into the temporal course of borderline PD (e.g., Gunderson, Stout et al., 2011; McGlashan et al., 2005; Wright et al., 2016), we found that borderline PD can be decomposed into a borderline proneness element that is stable over time and a dynamic element that fluctuates from year to year. Each of these processes explains approximately half of the overall level of borderline pathology at any moment. Additionally, as predicted by trait models of PD, both fixed and situational elements of borderline PD were strongly related to Five Factor Model trait dimensions. Distinctive patterns of association with childhood adversities and dimensions of temperament further support the construct validity of the stable versus dynamic factors. Overall, these findings are consistent with the view that borderline PD reflects a hybrid of stable traits and more dynamic features, which have potentially divergent causes and correlates.

Our results indicate that research focused on the underpinnings of borderline PD should distinguish its stable and dynamic elements. Because it is impossible to predict change in borderline proneness, research that conflates time-invariant and -varying dimensions will underestimate the signal of any predictive factor or intervention (see Cole, 2006; Cole et al., 2017). Research into the underlying biological (e.g., Bornovalova, Hicks, Iacono, & McGue, 2009; Distel et al., 2008; Torgersen et al., 2008) and environmental (e.g., Distel et al., 2011) liabilities to borderline PD should target the stable borderline proneness construct, which is free of “noise” caused by situational variability and measurement error.

The emergence of strong time-varying dimensions has implications for clinical formulations of borderline PD. The current results imply that practitioners need not rule out a borderline PD diagnosis just because symptoms wax and wane. Acute symptom change, typically

thought to exclusively characterize episodic conditions such as mania or substance abuse, is probably a credible feature of borderline pathology. The enduring and chronic nature of symptoms, therefore, may not be a sufficient criterion for differential diagnosis between borderline PD and, for example, mood disorders such as major depression. This interpretation is in line with results from an early qualitative study of borderline PD diagnoses in CLPS, in which 18 of 160 borderline PD cases achieved sustained remission within 6 months of the initial diagnostic assessment (Gunderson et al., 2003). Gunderson and colleagues ascribed such sudden improvements to, among other factors, environmental changes (e.g., exiting an abusive relationship) and psychiatric treatment. Indeed, our results reinforce the idea that focused psychiatric intervention is capable of deflecting the course of borderline PD symptoms. Further, they suggest that treatment efforts would likely benefit from distinguishing enduring versus acute borderline symptoms. It is possible that early treatment gains could be maximized by targeting features and correlates most amenable to change.

Along with these research and clinical implications, our results also bear on the still-evolving "hybrid model" of borderline PD. The dichotomy of temperamental and acute symptoms in the hybrid model—as postulated by Zanarini et al. (2007)—initially derived from observations of differential remission rates for diagnostic criteria (e.g., McGlashan et al., 2005). Accordingly, in the original formulation, it made predictions regarding absolute change over time (i.e., which symptoms were more likely to remit). This same model may not apply to research applications focused on differential stability (i.e., preservation of individuals' rank-ordering on borderline PD severity over time), the variety of change we examined here. That is, there is no theoretical reason to expect that borderline features exhibiting the highest absolute stability will also show large differential stability (e.g., Morey & Hopwood, 2013). Indeed, in the present study, the temperamental symptoms were not the ones most saturated with borderline proneness. If anything,

they were characterized by a *smaller* time-invariant dimension, consistent with prior research in the McLean Study of Adult Development showing smaller retest correlations over 2-year spans for putatively temperamental features (Hopwood et al., 2010). Thus, future theoretical and empirical work is needed to adapt this hybrid model for use in various research contexts. The model may look entirely different for tests of differential stability, and the present data provide a preliminary indication that perhaps it should.

Construct Validity of Borderline Proneness

This study builds upon the large literature connecting borderline PD to basic traits (Samuel & Widiger, 2008) by showing that normative personality traits could explain a substantial proportion of between-person variance in borderline PD features. Our approach specifically extends previous cross-sectional empirical work on observed variables by illuminating the "true" correlations—typically obscured to some extent by measurement error, mood-state distortion, and other transient sources of noise—between the stable components of these trait-like constructs. Neuroticism (r = .74) and Agreeableness (r = -.48) had particularly robust relations with borderline proneness. Moreover, we showed that the dynamic (i.e., state-like) elements of borderline PD were fairly well-captured by the dynamic elements of normative personality across follow-up waves in this study. The pattern of time-varying factor correlations largely mirrored the nature of associations among the stable, time-invariant factors, and ranged from r = .22 (Openness) to r = .64 (Neuroticism).

Second, we evaluated the association of borderline proneness with the trait-like component of a FFM facet-level composite of borderline PD dimensions based on expert consensus. This constellation of lower-order traits was originally theorized to represent the core features of borderline pathology at a finer level of resolution than the FFM domains permit (Lynam & Widiger, 2001). After omitting two facets from the Openness domain that did not empirically align

with the other FFM indices of borderline PD in our data, we discovered that the time-invariant factors of borderline PD (based on clinical interviews) and the FFM composite were very strongly related (r = .81), as were the corresponding time-varying factors (r =.63). This lends further validation to the hypothesis that borderline PD features can be captured systematically—albeit not completely—by normative personality variation. We argue that future efforts to trace the stsable personality underpinnings of borderline and other PDs—whether through a FFM lens, or other models of personality structure—should consider parsing the fixed substrates of PD from transient variation likely to obscure the time-invariant associations of disorder constructs with external factors (cf. Naragon-Gainey, Gallagher, & Brown, 2013).

We caution that while the FFM offers good statistical prediction of borderline proneness in these data, the FFM constructs may not be the only, or even the most important, foundations of borderline PD. Recent findings on the multivariate structure of PDs suggest that borderline PD overlaps markedly with a general liability for PD (Sharp et al., 2015; Wright, Hopwood, Morey, & Skodol, 2016). That is, in bifactor models that extract a general factor reflecting the common substrate of all PDs, borderline PD has minimal overlap with other PDs independent of this general liability (e.g., Wright et al., 2016). These results have been interpreted as indicating that borderline PD largely reflects core deficits in interpersonal functioning and identity formation, which form the basis of the general definition of PD in emerging PD diagnostic models (e.g., Bender et al., 2011). Borderline proneness may therefore represent, at least in part, core adaptive functioning problems that are common to the full range of PDs (see Kernberg, 1984; Turkheimer, Ford, & Oltmanns, 2008).

We looked beyond the FFM to further explicate the construct validity of the stable and dynamic borderline PD factors. All three forms of childhood maltreatment investigated here had strong effects on stable borderline proneness and virtually no influence on more acute fluctuations

in symptom severity. This finding is consistent with epidemiological evidence that childhood adversities instigate *sustained* risk for common mental disorders (e.g., McLaughlin et al., 2010). Paralleling the maltreatment results, we observed negative temperament and positive temperament had much more potent effects on borderline proneness than transient borderline pathology. Consistent with the correlation between neuroticism and borderline PD TSO trait factors (r = .74), negative temperament had a particularly large influence on borderline proneness (r = .79). Contradicting hypotheses, the disinhibition dimension appeared to be twice as strongly related to the dynamic component as to the stable component of borderline pathology. While disinhibition is both theoretically and empirically linked to borderline PD (e.g., Trull, 2001), no prior work has parsed its associations with enduring versus transient elements of the disorder. It is possible that in this patient sample disinhibition was particularly related to acute symptoms that motivated treatment. Often, such symptoms (e.g., self-damaging impulsive behaviors, non-suicidal self-injury, quasi-psychotic thinking) are the proximal triggers of clinical attention. We note, however, that this effect was unexpected and could be specific to treatment-seeking groups. More work in a variety of longitudinal research designs is needed to follow up on this finding and the other criterion validity results.

The GAF result was also partially inconsistent with our hypotheses. GAF ratings were moderately inversely related to both time-invariant and -varying factors, whereas we anticipated a specific linkage with dynamic borderline features (i.e., we envisioned that symptom flare-ups would be accompanied by worsening psychosocial impairment). Our post hoc interpretation of this result is that impairment is, to some extent, a stable feature of PD patients. In fact, multiple longitudinal CLPS studies have converged on the finding that, even in the context of PD symptom improvement, psychosocial functioning remains fairly steady over time, especially for borderline PD patients (e.g., Gunderson, Stout et al., 2011). Therefore, although GAF ratings are intended to

capture patients' current status, we argue that empirically they probably also reflect a somewhat enduring property of the patient.

We believe that, taken together, these associations with external criteria support the construct validity of the stable and dynamic elements of borderline PD. This study provides some evidence that borderline proneness is associated in expected ways with events and processes (e.g., child abuse, negative temperament) that are often implicated in etiological theories of borderline PD. Moreover, many of these associations were undeniably robust and large in magnitude, probably because borderline proneness excludes all *transient* sources of borderline PD variation (e.g., measurement error, short-lived environmental inputs) that are theoretically unrelated to most prominent etiological factors. At the same time, the dynamic elements of borderline pathology were systematically related to external correlates. For instance, time-varying borderline PD features were consistently associated with yearly fluctuations in normative personality traits and interview-based GAF ratings at study baseline. We advise investigators to prioritize research designs and statistical plans that can delimit the component(s) of borderline PD that is best suited to the particular research setting. For instance, studies on the genetic underpinnings of disorder would likely concentrate on borderline proneness, whereas research on psychological treatment or acute stressors may align better with dynamic components of borderline pathology.

Limitations

Our study benefitted from psychometrically sound interview assessments of borderline PD symptoms and self-report assessment of basic traits, a large patient sample with diverse principal PD diagnoses, and a decade-long follow-up data structure. A number of study limitations should be considered alongside these design strengths, however. First, the longitudinal structure of borderline pathology depends on several study attributes, including timeframe, sample illness severity, assessment method, and developmental stage. For instance, we might expect greater

instability over longer intervals, in patient (as compared to non-clinical) samples, and in young people (Roberts, Walton, & Viechtbauer, 2006; see also Wright, Zalewski, Hallquist, Hipwell, & Stepp, 2016). Along those lines, we found that Neuroticism levels were highly variable over 10 years in CLPS (i.e., as for borderline PD, nearly half of variation over time was state-like), whereas other research has reported stronger consistency, albeit over shorter intervals (e.g., Prenoveau et al., 2011). We recommend additional research into the longitudinal structure of Neuroticism and other FFM domains in diverse samples to determine the factors (e.g., illness severity, psychiatric treatment) that influence personality stability.

Second, multiple sources of information about patients' personality disorder symptoms could strengthen longitudinal models of borderline PD (e.g., Cole et al., 2017). TSO modeling is equipped to isolate the shared variance among patient, interviewer, and informant reports—which often disagree (Hopwood et al., 2008)—of PD symptoms. Third, the FFM trait composite of borderline PD overlapped significantly with Neuroticism, such that it may not offer much incremental explanation of borderline PD. This was partly because the Openness facets originally theorized to relate to borderline PD were not empirically related to the FFM composite in this dataset, and partly because borderline PD is intimately intertwined with Neuroticism (e.g., Trull, 2001). Other personality disorders are represented by a greater variety of FFM facets (Lynam & Widiger, 2001). Nevertheless, our results here regarding Openness facets suggest the need for further refinement of the personality architecture of borderline PD (e.g., DeShong et al., 2015). Fourth, the borderline PD diagnosis is notoriously heterogeneous (e.g., Clark, 2007), and its basic building blocks (e.g., affective disturbance, attachment insecurity) may vary in terms of stability. The TSO framework does not permit symptom-level (i.e., single indicator) analyses in this dataset, but we recommend future research into the temporal course of intermediate phenotypes for borderline PD. The FFM domains arguably represent one model of borderline PD heterogeneity

(e.g., Widiger & McCabe, 2018), and our results indicate that they are differentially stable over time. Fifth, there was significant attrition over follow-up in CLPS (although dropout rates compared favorably to other long-term studies). We used a missing data procedure that makes less restrictive assumptions than most other methods (Widaman, 2006), but some possibility for bias in our parameter estimates remains. Finally, there is considerable debate about the nature of the borderline PD concept itself, with some conceptualizations situating it as a general factor of personality pathology, others as a specific syndrome, and others as a superfluous concept. Thus, results may differ depending upon how borderline PD is conceptualized and measured.

Conclusion

Borderline PD features were found to be both stable and dynamic over 10 years in this patient sample. This result refutes the traditional view of borderline PD as a totally unyielding condition and opens up a new framework for research into the fixed and transient influences on borderline pathology. Indeed, our findings suggest that these two elements of borderline PD may have distinctive causes, correlates, and consequences.

Footnotes

[1] "Hybrid model" here refers to a model of borderline pathology consisting of more stable temperamental characteristics and more transient acute symptoms (McGlashan et al., 2005; Zanarini et al., 2007) and is to be distinguished from the hybrid dimensional/categorical model of BPD consisting of characteristic impairments in personality functioning and a set of pathological personality traits in the Alternative DSM-5 Model for Personality Disorders (American Psychiatric Association, 2013).

[2] We evaluated whether autoregressive coefficients and occasion factor residual covariances could reasonably be constrained to equality across waves by comparing the fit of nested models in which these parameters were alternately restricted or freely estimated across time. Analyses showed that the restriction did not lead to substantial deterioration in model fit from the perspective of statistical significance, $\chi^2_{diff}(5) = 11.32$, $p = .05$, or in terms of CFI, TLI, or RMSEA (identical values—to 3 decimal places—across models).

[3] To examine possible biasing effects of restriction of range associated with patients who never expressed borderline PD symptoms, we performed an *ad hoc* analysis that excluded all patients who were symptom-free across all waves in which they participated. Only 18 (2.7% of baseline sample) such patients were identified, and TSO results were unaffected by their omission.

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Table 1: Trait-State-Occasion Model Estimates for Borderline Personality Disorder

	Borderline Personality				
Measure	Baseline	Year 2	Year 4	Year 6	Year 10
Total variance (unstandardized)	1.46	1.46	1.46	1.46	1.41
Time-invariant variance (unstandardized)	0.63	0.63	0.63	0.63	0.63
Time-variant variance (unstandardized)	0.83	0.83	0.84	0.84	0.78
Proportion of variance due to time-invariant component	42.9%	42.9%	42.9%	42.9%	44.6%
Proportion of variance due to time-variant component	57.1%	57.1%	57.1%	57.1%	55.4%
Stability coefficient (unstandardized/standardized)	—	0.59/.59	0.59/.59	0.59/.59	0.53/.55

Note. N = 668. Model fit: $\chi^2(887) = 1{,}225.47$, $p < .001$; CFI = .98; TLI = .98; RMSEA = 0.02; WRMR = 1.12. All parameter estimates are statistically significant at the .001 level.

Table 2: Trait-State-Occasion Model for Acute and Temperamental Borderline Personality Disorder Symptoms

	Acute Symptoms[a]				
Measure	Baseline	Year 2	Year 4	Year 6	Year 10
Total variance (unstandardized)	1.24	1.27	1.28	1.29	1.27
Time-invariant variance (unstandardized)	0.60	0.60	0.60	0.60	0.60
Time-variant variance (unstandardized)	0.65	0.68	0.69	0.69	0.67
Proportion of variance due to time-invariant component	48.0%	46.9%	46.5%	46.4%	47.1%
Proportion of variance due to time-variant component	52.0%	53.1%	53.5%	53.6%	52.9%
Stability coefficient (unstandardized/standardized)	—	0.62/.61	0.62/.62	0.62/.62	0.60/.61
	Temperamental Symptoms[b]				
Total variance (unstandardized)	1.85	2.17	2.33	2.40	2.11
Time-invariant variance (unstandardized)	0.83	0.83	0.83	0.83	0.83
Time-variant variance (unstandardized)	1.02	1.34	1.50	1.57	1.28
Proportion of variance due to time-invariant component	45.0%	38.5%	35.9%	34.7%	39.5%
Proportion of variance due to time-variant component	55.0%	61.5%	64.1%	65.3%	60.5%
Stability coefficient (unstandardized/standardized)	—	0.71/.62	0.71/.67	0.71/.69	0.53/.59

[a] Model fit: $\chi^2(142) = 138.79$, $p = .56$; CFI = 1.00; TLI = 1.00; RMSEA = 0.00; WRMR = 0.68. All parameter estimates are statistically significant at the .001 level.
[b] Model fit: $\chi^2(241) = 335.90$, $p < .01$; CFI = .99; TLI = .99; RMSEA = 0.02; WRMR = 0.92. All parameter estimates are statistically significant at the .001 level.

Table 3: Time-Invariant and Time-Varying Factor Correlations from Bivariate Trait-State-Occasion Models

	1	2	3	4	5	6
1. Borderline personality disorder	—	.216[b]	-.324[a]	-.321[a]	-.300[a]	.635[a]
2. Openness	-.146	—	.104[b]	.558[a]	.243[a]	-.031
3. Conscientiousness	-.380[a]	.185[a]	—	.480[a]	.273[a]	-.693[a]
4. Extraversion	-.336[a]	.498[a]	.473[a]	—	.414[a]	-.651[a]
5. Agreeableness	-.477[a]	.271[a]	.283[a]	.573[a]	—	-.325[a]
6. Neuroticism	.737[a]	-.040	-.575[a]	-.568[a]	-.092	—

Note. $N = 662$. Correlations reflect associations between factors extracted in "bivariate" trait-state-occasion models. Time-invariant (i.e., trait) factor correlations appear below the diagonal, and time-varying (i.e., occasion) residual factor correlations above the diagonal. For example, in a joint trait-state-occasion model of borderline personality disorder and Neuroticism, the correlation between the time-invariant factors—reflecting the perfectly stable components of these two constructs across the study timeframe—was .737. Thus, 15 bivariate trait-state-occasion models were estimated to compute the correlations presented here. [a] $p < .001$, [b] $p < .05$.

Table 4: Regressions of Time-Invariant and Time-Varying Borderline Personality Disorder Factors on Childhood Maltreatment, Temperament, and Global Assessment of Functioning

	Time-Invariant Factor				Baseline Time-Varying Factor			
	b	*SE*	*p*	*β*[a]	*b*	*SE*	*p*	*β*[a]
Childhood Maltreatment								
Abuse	0.88	0.15	< .001	1.04	-0.06	0.15	.70	-.06
Neglect	0.69	0.15	< .001	0.88	0.04	0.16	.79	.04
Witnessing violence	0.53	0.14	< .001	0.68	0.14	0.15	.37	.15
Temperament								
Negative temperament	0.05	0.01	< .001	.79	0.05	0.02	.003	.31
Positive temperament	-0.02	0.01	.012	-.21	0.00	0.01	.924	.01
Disinhibition	0.02	0.01	.253	.14	0.05	0.02	.002	.30
GAF	-0.02	0.01	.003	-.42	-0.03	0.01	.002	-.31

Note. All predictors were assessed at the study baseline wave. Each predictor was examined in a separate structural equation model to minimize collinearity and model complexity. Sample sizes for maltreatment, temperament, and GAF analyses were 604, 666, and 668, respectively. *SE* = standard error. GAF = global assessment of functioning.

[a] Beta values for maltreatment variables were *y*-standardized, such that they reflect the expected change in standard units in the outcome per one unit increment in predictors. All other beta values reflect completely standardized structural paths.

Figure Caption

Figure 1. Trait-state-occasion model for borderline personality disorder. The borderline PD "state" factors load onto both time-invariant (TI), or "trait," and time-varying (TV), or "occasion," factors. Each state factor captures the shared variance of all 9 borderline PD diagnostic criteria at a given assessment wave. State factors (labeled BP1-BP5) therefore are measurement error-free representations of borderline pathology at a particular wave. The TI factor is theorized to reflect the completely stable core of borderline proneness. The TV factors reflect situational influences (e.g., transient life stressors, temporary medication regimen) on borderline pathology that do not persist for the entire study timeframe. The "s" coefficients are autoregressive paths. The manifest variable subscripts represent wave (first subscript) and item (second subscript) numbers. Thus, B_{19} represents the ninth borderline PD criterion (i.e., stress-linked paranoia) at the first assessment wave, whereas B_{59} represents that same criterion at the fifth and final wave. For clarity of presentation, error covariances are not shown.