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Modeling Heterogeneity in Momentary Interpersonal and Affective Dynamic Processes in Borderline Personality Disorder

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Abstract

Borderline personality disorder (BPD) is a diagnosis defined by impairments in several dynamic processes (e.g., interpersonal relating, affect regulation, behavioral control). Theories of BPD emphasize that these impairments appear in specific contexts, and emerging results confirm this view. At the same time, BPD is a complex construct that encompasses individuals with heterogeneous pathology. These features—dynamic processes, situational specificity, and individual heterogeneity—pose significant assessment challenges. In the current study, we demonstrate assessment and analytic methods that capture both between-person differences and within-person changes over time. Twenty-five participants diagnosed with BPD completed event-contingent, ambulatory assessment protocols over 21 days. We used p-technique factor analyses to identify person-specific psychological structures consistent with clinical theories of personality. Five exemplar cases are selected and presented in detail to showcase the potential utility of these methods. The presented cases' factor structures reflect not only heterogeneity but also suggest points of convergence. The factors also demonstrated significant associations with important clinical targets (self-harm, interpersonal violence).

Keywords

borderline personality disorder; idiographic analysis; p-technique factor analysis; ambulatory assessment; event-contingent recording

Borderline personality disorder (BPD) is a complex clinical construct that differs in its manifestation between individuals (i.e., is heterogeneous) and within individuals over time (i.e., is dynamic in its expression). There have been efforts to model both individual differences in BPD (e.g., Hallquist & Pilkonis, 2012) and variability in the core features of BPD over time (see Santangelo, Bohus, & Ebner-Priemer, 2014, for a review). Here, our

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goals are to integrate these two lines of inquiry, to demonstrate how person-specific (i.e., idiographic) *dynamic structures* can be estimated from appropriate assessment data, and to link these structures to relevant theory.

Heterogeneity is inherent in BPD's polythetic criteria set, which includes impairments in the domains of interpersonal, affective, and behavioral regulation. Several studies have confirmed that individuals diagnosed with BPD share certain core features but that they also diverge in terms of characteristic interpersonal style and affective tendencies (Hallquist & Pilkonis, 2012; Lenzenweger, Clarkin, Yeomans, Kernberg, & Levy, 2008; Wright et al., 2013). Although this reflects expected individual differences in a complex phenotype, it poses problems for clinical assessment, communication, treatment development, and research.

Furthermore, BPD is a pathology defined by dynamic processes that ebb and flow over time and across diverse contexts. For instance, as a group, those diagnosed with BPD vary more affectively and interpersonally than nondiagnosed controls (J. J. Russell, Moskowitz, Zuroff, Sookman, & Paris, 2007) and, for certain emotions, more than clinical controls diagnosed with depression (Trull et al., 2008). Additional research has highlighted the importance of shifts between negative and positive emotional states (Coifman, Berenson, Rafaeli, & Downey, 2012; Ebner-Primer et al., 2007; Houben, Vansteelandt, et al., 2016), although these patterns are unlikely to be diagnosis specific (Houben, Bohus, et al., 2016). Among individuals diagnosed with personality disorders (PDs), recent findings suggest that maladaptive behavior varies as much within-person across days as it does between-person (Wright & Simms, 2016).

One implication of such emotional and behavioral variability is that specific situations encountered in daily life evoke these shifts. As such, greater variability results from the dynamic efforts of individuals to regulate in response to diverse situations. Several studies support this perspective, showing that feelings of rage (Berenson, Downey, Rafaeli, Coifman, & Paquin, 2011) and interpersonal hostility (Sadikaj, Moskowitz, Russell, Zuroff, & Paris, 2013) occur when others are perceived as rejecting or hostile, respectively. Miskewicz et al. (2015) also found that individuals with BPD experienced increased symptomatology in response to a variety of situational stressors.

These investigations into contextualized dynamic processes are consistent with theories in personality and clinical psychology, including interpersonal theory (Hopwood, Pincus, & Wright, in press), attachment theory (Mikulincer & Shaver, 2016), and object-relations theory (Kernberg, 1984). Here, we select interpersonal theory as a lens for studying dynamic processes in BPD. Interpersonal theory argues that *interpersonal situations* are the crucible for personality development and its expression, which involves overt behavior in the proximal situation, mental construal of the situation, and felt security or anxiety (Pincus & Ansell, 2013). That is, interpersonal theory defines personality in terms of an individual's characteristic dynamic patterning of social behavior, perceptions of the self in relation to the other, and associated affect across situations in an individual's life. The two dimensions of dominance and affiliation serve to organize interpersonal functioning, both in terms of overt behavior and mental construal. In contemporary interpersonal theory, situations are also

colored by the degree to which the individual experiences positive or negative affect in the context (Hopwood, Pincus, et al., in press). Thus, from this perspective, the pattern of interpersonal interactions that constitutes personality includes (a) the individual's perception of the other's dominance and affiliation, (b) the individual's dominant and affiliative behavior toward the other, and (c) the individual's positive and negative affect in the moment. By extension, individual differences in personality are reflected in differential patterns of the levels and links among interpersonal perceptions and behavior, and affect as they manifest in situations.

The studies reviewed above offer much needed empirical glimpses into the dynamics outlined by interpersonal theory, as well as other similar articulations (e.g., attachment, object–relations). However, they do not fully encompass the theoretical descriptions of interpersonal situations because the studies have focused largely on modeling univariate fluctuations or predicting single dependent variables as opposed to modeling the interrelations among the multivariate theoretical components that define an interpersonal situation. To understand more fully the dynamic processes outlined in *theoretical* models, *statistical* models are needed that can incorporate and simultaneously model the associations among each piece of the model (i.e., other behavior, self-behavior, affect). In the case of interpersonal theory (and related theories mentioned above), this would involve evaluating the structure of complex multivariate data in the form of dominance and affiliative behavior, perceptions of dominance and affiliative behavior, and diverse affective states sampled from an individual repeatedly over time.

Although a number of quantitative approaches are relevant to this task, *p-technique factor analysis* (Cattell, 1963; Cattell, Cattell, & Rhymer, 1947) allows for examination of the *structure* of an individual's multivariate situational behavior across time. P-technique factor analysis involves the same analytic procedures as the more familiar r-technique factor analysis, but is applied to data of a different type. R-technique, the most commonly used form of factor analysis, involves fitting a factor model to a multivariate data set collected from a single observation across multiple individuals. In contrast, p-technique involves factor analyzing a multivariate data set collected from multiple observations in a single individual. P-technique models are dynamic in the sense that they model patterns of covariation among variables that are assessed together over time.¹ Thus, it reveals patterns of variables that are coupled together over time, or an individual's *dynamic structure*.

P-technique approaches have a long, albeit sporadic, history of use in personality and clinical psychology having been applied to the within-person structure of emotion, personality, symptoms, and psychotherapeutic process (e.g., Borkenau & Ostendorf, 1998; Cattell & Luborsky, 1950; R. L. Russell, Jones, & Miller, 2007; Zevon & Tellegen, 1982). Here, we continue in this tradition by using p-technique to examine the structure of perceptions of other behavior, self-reported behavior, and affect. We build on previous work by Fournier, Moskowitz, and Zuroff (2008, 2009) who studied “interpersonal signatures” by

¹p-Technique factor analysis has been extended to what has been termed *dynamic* factor analysis (McArdle, 1982; Molenaar, 1985). These extended models also specify relationships among the variables between time-points (i.e., lagged relationships). Thus, “dynamic” may refer to associations from one time to the next, as well as to the meaning we use here, which is the covariation of variables that fluctuate together over time.

examining the patterns of covariation in self-ratings of interpersonal behavior measured repeatedly in daily life. They found that, after controlling for situational influences (i.e., ratings of other behavior), self-rated interpersonal behavior conformed, on average, to the structural predictions of the interpersonal circumplex model. However, they also found significant between-person heterogeneity in this structure.

Here, we expand on this work by including perceptions of the other's behavior (both dominance and affiliation) and one's own affect (negative and positive affect scales) alongside self-reported behavior (both dominance and affiliation), and affect, as assessed in interpersonal situations in daily life. By applying p-technique factor models to an individual's multivariate time series, a set of factors will be estimated that are defined by patterns of loadings of self and other interpersonal behavior and affect, and which could be interpreted as interpersonal "situational signatures." That is, the resulting factors can be understood as reflecting the idiographic structure of personality proposed by interpersonal theory.

The Current Study

Our overarching aim in the current study was to demonstrate the utility of using p-technique factor analysis for investigating idiographic "situational signatures" (i.e., the dynamic patterning of interpersonal perception, behavior, and affect during social interactions) in a sample of individuals diagnosed with BPD. To achieve this aim, we subjected ratings of one's own interpersonal behavior, a partner's interpersonal behavior, and affect from a 21-day, event-contingent, ambulatory assessment protocol to p-technique factor analyses in 25 participants from a larger study of the effect of BPD on romantic relationships. From these, we selected a subsample of five participants to present in detail. We hypothesized that these idiographic models would differ in the number and patterning of their interpersonal "situation signatures." Additionally, we sought to demonstrate that these signatures would have meaningful associations with important clinical events (e.g., self-harm, interpersonal violence, substance use).

Method

Participants

Romantic couples were recruited via flyers posted in psychiatric treatment clinics. The parent study from which these data are drawn was designed to investigate the role of PDs in the functioning of romantic couples. The larger study used a stratified design, such that target participants (identified patients) were screened by phone for both borderline and general personality disorder using the McLean Screening Instrument for Borderline Personality Disorder (Zanarini et al., 2003) and the Inventory of Interpersonal Problems Personality Disorder Scales (Pilkonis, Kim, Proietti, & Barkham, 1996), respectively. Participants reflected a spectrum that ranged from a positive screen for BPD to a positive screen for any other PD to few or no symptoms of PD. Patients were excluded if they met criteria for a lifetime diagnosis of bipolar disorder or psychosis.

Twenty-seven participants met the diagnostic threshold for BPD (i.e., 5 criteria) based on clinical interview (described below), and 25 completed sufficient event recordings for idiographic analyses. Of these, five were selected as exemplars for detailed presentation. These five were selected to be representative of the breadth of the number of factors to emerge from p-technique factor analyses in the larger sample.

Procedure

Each participant was given a Samsung Galaxy S3 cell phone with a preloaded web application designed for this study. Participants were instructed in how to use the web application to submit records about their mood, behavior, and interpersonal interactions every day for 21 days. Instructions specified that records were to be completed immediately following every interpersonal interaction that lasted at least 10 minutes.

Measures

Psychiatric Diagnoses—To establish psychiatric diagnoses and symptom severity, participants were interviewed using the Structured Clinical Interview for DSM-IV Axis I Disorders (*SCID-I*; First, Spitzer, Gibbon, & Williams, 1997) and the Structured Interview for DSM-IV Personality (*SIDP-IV*; Pfohl, Blum, & Zimmerman, 1997). To determine interrater agreement, video recordings of the SCID-I and SIDP-IV interviews from a randomly selected sample of five participants were reviewed and scored independently by five alternate reviewers. Agreement was excellent for the severity of BPD symptoms (intraclass correlation coefficient = .98) and severity of the sum of all other PD symptoms (intraclass correlation coefficient = .94). Agreement was excellent for a current anxiety disorder ($\kappa = 1.00$) and was adequate for current substance use disorder ($\kappa = 0.72$), and current mood disorder ($\kappa = 0.55$).

Event-Contingent Records of Interpersonal Interactions—Participants were asked to complete the electronic diary following each interpersonal interaction that lasted longer than 10 minutes. The diaries assessed the participants' own interpersonal behavior, their perception of their interaction partner's interpersonal behavior, and the participant's affect. Additional questions targeted contextual information about the nature of the interaction, including the interaction partner's relationship to the participant. When multiple interaction partners were present, participants selected which one to rate. Each record also included items assessing self-harm, violence, and substance use.

Affect Assessment—Each electronic diary record presented 19 negative affect and 10 positive affect adjectives on a 5-point scale (1 = *very slightly or not at all*, 5 = *extremely*) from the Positive and Negative Affect Schedule–Extended version (Watson & Clark, 1999). The 10 positive affect items were averaged to create a Positive Affect score, 6 negative affect items were averaged to create an Anxiety scale, 6 were averaged to create a Hostility scale, 2 were averaged to create a Guilt scale, and the remaining 5 were averaged to create a Sadness scale. Descriptive statistics for the five exemplar participants can be found in supplementary materials (Table S1 available online at <http://asm.sagepub.com/content/by/supplemental-data>).

Interpersonal Behavior Assessment—Interpersonal behaviors of the participant and the participant's perceptions of the partner's behavior during the interaction were assessed using the Social Behavior Inventory (Moskowitz, 1994). The Social Behavior Inventory is a checklist (i.e., rated *yes* or *no*) of 46 behavioral items designed to assess the two dimensions of the interpersonal circumplex, dominance, and affiliation. The dominant dimension includes Dominant (e.g., *I expressed an opinion; I asked the other to do something*) and Submissive (e.g., *I gave in; I let the other make plans or decisions*) behaviors. The affiliative dimension includes Quarrelsome (e.g., *I criticized the other; I made a sarcastic comment*) and Agreeable (e.g., *I listened attentively to the other; I expressed reassurance*) behaviors.

For the participants' self-ratings, they responded to a subset of 12 items during each interaction. Consistent with previous research (Sadikaj et al., 2013), we created four forms composed of three items from the poles of each interpersonal behavior dimension to decrease the likelihood of participants adopting a patterned way of responding to these items. Thus, each form contained 12 interpersonal behavior items, and forms were administered in a daily cycle. We created two subscales corresponding to dominance (*Dominance = Dominant–Submissive*) and affiliation (*Affiliation = Agreeable–Quarrelsomeness*) dimensions of interpersonal behavior.

Participants rated their perceptions of their interaction partner's behaviors on a subset of seven items that did not vary randomly. These items were scored similarly for dominance and affiliation by the partner. Descriptive statistics for interpersonal behavior can also be found in supplementary Table S1.

Aggression Assessment—Participants indicated whether they had experienced an *urge to hurt the other person*, they had *threatened to harm the other person*, or they engaged in behavior to harm the other person (*Did you do anything to harm her or him?*) during the interpersonal interactions. If participants endorsed harming the other, they indicated the type of violent behavior (e.g., *threw something at her or him that could hurt, pushed or shoved her or him, punched or hit her or him*). They also reported on whether the other had threatened or done something to harm them. In a parallel fashion, participants indicated whether they had experienced an urge to engage in self-harm (*Did you have an urge to harm yourself on purpose?*), whether they had threatened to engage in self-harm (*Did you threaten to harm yourself on purpose?*), and whether they engaged in self-harm (*Did you do anything to harm yourself on purpose?*) during the interpersonal interactions. If participants endorsed engaging in self-harm behavior, they indicated the method of self-harm (e.g., *cut oneself, burned oneself, punched oneself*). Due to the low frequency of these behaviors (0.1% to 3.4% of interactions), we created three dichotomous scores reflecting whether the participant reported (a) engaging in any self-harm, (b) engaging in any interpersonal aggression directed toward the other (experienced urges, threatened, or engaged in the behavior), or (c) being the target of interpersonal aggression by the other.

Substance Use Assessment—Participants indicated whether they *drank alcohol, used street drugs or someone else's prescription medication, or were high or intoxicated* during the interpersonal interactions. If participants endorsed using drugs or someone else's prescription medication, they indicated the type of drug (e.g., marijuana, benzodiazepines)

consumed. The same questions were asked about the other's substance use during the interaction. Substance use was reported infrequently (4.0% of interactions); thus, we created two dichotomous scores reflecting whether the participant reported using alcohol or other substances during the interaction.

Data Analyses

Participants' multivariate time series of *Self-Dominance*, *Self-Affiliation*, *Other Dominance*, *Other Affiliation*, *Positive Affect*, *Anxiety*, *Hostility*, *Guilt*, and *Sadness* were subjected to exploratory principal axis factoring in Stata 14.1 (StataCorp, 2015). The principal axis method was chosen over maximum likelihood estimation because it does not assume multivariate normality and is less likely to produce improper solutions (see Finch & West, 1997, for a review). This is especially true when the data are nonnormal, and there are likely to be few observed variables loading on each factor, as is the case here.² We decided on the number of factors to retain by first using Horn's parallel analysis as implemented in the Stata program (fapara) to establish an upper bound on the number of factors. Then, models with successively fewer factors were run, and the model with the largest number of interpretable factors was retained for each participant.

For the five exemplar participants, we estimated factor scores using the regression method, and then calculated point-biserial correlations between the factor scores and several contextual and clinical variables. These variables included whether participants were interacting with their romantic partner or another individual (coded 1 and 0, respectively), whether participants reported using alcohol or drugs, whether their interaction partner was using alcohol or drugs, and whether there was violence toward the self or interaction partner during the interaction.

Results and Idiographic Model Interpretation

In the sample of individuals diagnosed with BPD, participants completed a median of 74 valid interpersonal event recordings ($M = 86$, $SD = 71$, range = 30-192). Parallel analyses suggested that exploratory factor analyses fit to the individual multivariate time series of these participants could, on average, retain up to three factors ($Mdn = 3$, range = 1-6). Of these 25 participants, we selected five that are representative of the heterogeneity in factor solutions. Person-specific diagnostic features are summarized in Table 1, and parameters for each factor analytic model are presented in Table 2. Models are presented in ascending order of complexity (i.e., increasing numbers of factors).

Participant A

This individual was a male in his late 20s.³ He was complex diagnostically, meeting the threshold for three additional PDs (antisocial, narcissistic, and avoidant), as well as several current and past clinical syndromes (see Table 1). He endorsed features from every PD except dependent. In contrast to his diagnostic complexity, his person-specific factor

²Efforts to fit these models using maximum likelihood factoring resulted in Heywood cases and improper solutions for the majority of participants.

³Demographic information is intentionally limited to protect participant confidentiality.

solution was among the least complex, resulting in a single factor accounting for 56% of the variance in his interpersonal diary reports. The pattern of loadings suggests the factor might be best interpreted as a single dimension of situational Positivity–Negativity. All negative affect scales loaded strongly and positively, positive affect loaded negatively, and both self and other affiliation loaded negatively. Interestingly, perceptions of others' dominance loaded positively, suggesting that situations in which others were perceived as dominant were also characterized by negative affect and interpersonal hostility. This dimension was significantly associated with violence toward others ($r = .38, p < .001$), but associations with all other events were not significant. Thus, in situations characterized by high Negativity, there was significant risk for interpersonal violence.

Participant B

This individual was a female in her late 30s. She endorsed the most BPD features (eight) of the exemplar participants, met diagnostic threshold for obsessive–compulsive PD, exhibited considerable affiliative personality pathology (i.e., elevated histrionic and dependent PD features), and met criteria for several clinical syndromes. Relative to Participant A, this individual had a factor solution that suggested greater nuance in her experience of interpersonal situations. Her solution resulted in two factors that accounted for 56% of the variance in the diary scales, and which might be labeled Interpersonal Positivity and Negative Affectivity. Interpersonal Positivity was characterized by self and other affiliation, positive affect, and viewing the other as dominant and the self as submissive. Unsurprisingly, given this individual's diagnostic profile, she experienced positive affect when others were perceived as being actively engaged with her. Negative Affectivity was defined by large loadings from each of the negative affect scales, although interestingly this factor was also marked with the participant's own dominance. Interpersonal Positivity was negatively associated with interacting with her romantic partner ($r = -.52, p < .001$), self-harm ($r = -.28, p = .029$), and violence toward the other ($r = -.36, p = .005$). In contrast, Negative Affectivity was significantly associated with self-harm ($r = .42, p < .001$) and violence toward the other ($r = .40, p = .002$). All remaining associations with events were not significant, and this participant never reported that the other was violent toward her.

Participant C

This individual was a female in her late 20s. She met the diagnostic threshold for BPD and paranoid PD and displayed features from several other PDs. She endorsed current cannabis use, as well as past major depressive and alcohol use disorders. Her person-specific factor model resulted in three factors that accounted for 51% of the variance in the indicators. These factors might be interpreted as Negative Affectivity, Agreeableness, and Engaged Other. Negative Affectivity had moderate to large positive loadings from all negative affect scales and a negative loading from the positive affect scale, as well as modest secondary loadings for other quarrelsomeness and dominance, and self-submissiveness. Agreeableness was marked strongly by self-affiliation, self-submissiveness, other affiliation and submissiveness, positive affect, and a negative loading for hostility. Interestingly, guilt exhibited a moderate positive loading on this factor. Finally, Engaged Other had large loadings from other dominance and affiliation but little else. Negative Affectivity was positively associated with interacting with the romantic partner ($r = .17, p = .033$), as well as

interpersonal violence toward ($r = .45, p < .001$) and from ($r = .28, p < .001$) her interaction partner. Agreeableness had roughly the opposite pattern of associations—it was negatively associated with interpersonal violence toward ($r = -.48, p < .001$) or against ($r = -.34, p < .001$) the participant.

Participant D

Participant D was a female in her early 30s. In addition to endorsing seven of nine BPD features, she met the diagnostic threshold for antisocial, avoidant, and dependent PDs. She also endorsed symptoms consistent with a major depressive disorder, agoraphobia, social phobia, and obsessive–compulsive disorder. She had a current and past history of polysubstance use. Her idiographic model resulted in a four-factor solution that accounted for 47% of the variance in her interpersonal interaction scores. It is notable that Factors 1 and 3 for this individual were highly similar to Factors 1 and 3 for Participant C, with Tucker congruence coefficients of .89 and .94, respectively. Thus, these factors can be similarly construed as Negative Affectivity and Engaged Other. Also, Factor 2 bore similarity to Participant C's Factor 2 in terms of interpersonal loadings, with a congruence of .92. Thus, it may warrant a similar interpretation of Agreeableness. Finally, Positive Affect emerged as a distinct domain for this participant. The Engaged Other factor was negatively associated ($r = -.31, p < .001$) with being with her romantic partner as opposed to others. Self-harm was associated with Negative Affectivity ($r = .28, p < .010$), low Agreeableness ($r = -.42, p < .001$), and low Positive Affect ($r = -.27, p < .015$). Finally, violence toward the other was negatively associated with Agreeableness ($r = -.28, p < .010$). The participant reported experiencing no violence from others, and all other associations were not significant.

Participant E

This individual was a female in her late 20s. Diagnostically, this individual endorsed criteria consistent with avoidant and dependent PDs, in addition to seven of nine BPD features. Consistent with the endorsed PD features, she also was diagnosed with major depressive disorder and social phobia. This individual's pattern of interaction variable endorsement resulted in the most differentiated factor structure. Affect split apart into Anxious Hostility and Low Positive Emotionality. Her own interpersonal behavior diverged into the more basic Dominance and Affiliation dimensions, colored with positive affect and other submissiveness, respectively. Perceptions of other interpersonal behavior were captured by a single factor defined by positive loadings from both other Dominance and Affiliation, and, to a lesser extent, positive affect. Thus, an interpretation of Engaged Other, similar to the previous two participants, is warranted. Interactions with the romantic partner were associated with lower Anxious Hostility ($r = -.33, p = .040$) and higher Self-Dominance ($r = .52, p < .001$). This individual reported alcohol use, which was not associated with any interaction factors, but none of the other clinically meaningful events investigated here.

Discussion

Several maladaptive dynamic processes are characteristic of BPD, including impairments in interpersonal relating, affective regulation, and behavioral control. Additionally, marked

individual differences exist in how the pathology is manifested. Thus, BPD represents a complex clinical construct characterized by heterogeneity in expression between and within individuals over time. Because of this, assessing clinically relevant dynamic processes has proven challenging. Further complicating the issue, borderline pathology reflects the interplay of several diverse behavioral systems within an individual. Even interpersonal theory, which emphasizes the role of social functioning as primary, describes the interplay of multiple variables over time (i.e., behavior, perceptions, affect). We addressed these challenges by using p-technique factor analysis to model person-specific situational signatures in data collected from a 21-day event-contingent, ambulatory assessment protocol. As expected, we found considerable heterogeneity in the resulting structures in a sample of 25 individuals diagnosed with BPD. We selected five individuals for illustration and highlighted key aspects of the factor solutions.

The Five Exemplar Cases

The exemplar cases illustrate several salient issues. First, p-technique solutions differed in the number of meaningful factors that emerged. Descriptively, this means that individuals differed in the degree to which they discriminated among the momentary assessment items. It is plausible that this reflects differences in the psychological nuance with which individuals approach interpersonal situations. Indeed, the individual with the most severe total PD score (Participant A) had the least differentiated factor solution, distinguishing only between positive and negative. Participant B had a slightly more differentiated solution (i.e., two negatively correlated factors), but both Participant A's and B's solutions may be reflective of what has been termed “splitting” or “black-and-white thinking.” Although this interpretation is tempting, it remains speculative given that these patients were drawn from a research protocol. Were these to be results from individual patients in treatment, these structural features could serve as an initial hypothesis for the clinician to investigate. These results can also serve as an initial hypothesis for future nomothetic research in a larger sample not limited to patients with BPD, and with clinician ratings of other important outcome variables (e.g., self pathology, psychosocial functioning, improvement in therapy, etc.).

Examining these first two structures from an interpersonal theory perspective, we see that these individuals' situational structure are defined by perceiving others as either hostile and controlling or warm and yielding, and their affective valence tends to track along with perceptions of others as well. We also see evidence for the interpersonal theory principle of complementarity: dominance pulls for submissiveness, and affiliation invites affiliation, and vice versa in interactions (see Sadler et al., 2011, for a review). In the case of Participant A, we see that he has a tendency to complement the other's hostility, whereas Participant B complements others warm and yielding behavior, but has no systematic response to other's hostile and controlling behavior.

Similarities were also observed across factor solutions. For instance, all but one participant (E) had a factor on which all the negative emotions loaded strongly. This result suggests such that negative emotions tend to rise in unison for these individuals. Furthermore, all but one participant (A) had a factor defined most strongly by positive loadings of other

dominance and affiliation, which we labeled “Engaged Other.” Although slight differences exist in the exact patterns of loadings, this suggests that perceiving others as either engaged or withdrawn is a shared psychological feature of this group. Each of these features is consistent with aspects that are central to the BPD construct, such as undifferentiated negative affectivity, and the general attunement to partner engagement and withdrawal. Systematic research in larger and diagnostically diverse samples is needed to determine whether these factors frequently emerge regardless of diagnosis, and whether there are meaningful differences between individuals in their structure (e.g., in the strength of the indicator loadings).

In some instances, factors were defined by one of the three variables types we used (affect vs. own behavior vs. other behavior). In other instances, however, the factors could be interpreted in terms of the full interpersonal theory model (or other theoretical frameworks, e.g., relational schema, object–relations dyads). For example, Participant A's single factor suggests he has problems when he perceives others as dominant, and this results in his own negative affectivity and quarrelsomeness. This interpretation is consistent with his elevation on narcissistic and antisocial PDs based on clinical interview. In contrast, with Participant B, who has problems with overinvestment in seeking out and needing the attention and affection of others (e.g., dependent and histrionic diagnoses), we found that she views situations characterized by mutual engagement as highly positive.

Finally, we found that the factors were often associated with key clinical behaviors (e.g., self-harm, interpersonal violence). In some cases, these findings suggest important clinical insights. For example, consider the results for Participants B and D, which suggest that self-harm is not merely associated with affective states, but also diverse interpersonal contexts. We did not find significant associations with substance abuse in the selected sample of individuals, although we did find several modest associations ($r_s \sim .20$). Thus, strongest associations were with the self and interpersonal aggression variables, as might be expected given the nature of the estimated factors.

Implications for Clinical Care

When considering applying this type of assessment in a clinical context, two principal issues arise: feasibility and utility. Addressing the feasibility question first, can this be done? Although the current approach may seem daunting to apply in practice, many of the necessary components are already in place. First, smartphones are ubiquitous, with the majority of adults using one. For most patients, loading an application on their phone would be all that is necessary to begin data collection. Second, the analytic architecture used here is a variant of factor analysis, familiar to most clinical psychologists from their graduate training. Others have also argued that ambulatory assessment coupled with idiographic analysis is feasible (see Roche et al., 2014).

Would this approach be useful? At the outset, treatment for BPD involves identifying the contexts and contingencies of a patient's maladaptive processes. This is most often accomplished by listening for themes in the patient's narrative, which offers rich data, but is also time consuming and relies on the patient's selection of events to report. It is recognized that additional data from the patient's life between sessions are advantageous, and many

treatments, including some for BPD, make use of diary measures. However, these most often serve as records of symptoms and skills, but do not provide an assessment of the individual's psychological structure. What the approach presented here offers is a flexible framework for assessing complex dynamic processes that involve multiple components. In this way, the approach goes beyond symptom tracking to clarify the interpersonal context in which many symptoms occur.

Bridging the Idiographic and Nomothetic

It was our aim to emphasize the heterogeneity in the idiographic dynamic structures. In clinical practice, a detailed understanding of the individual is necessary. However, the utility of these types of approaches for clinical science rests on their ability to provide generalizable findings with nomothetic applicability. Methods that bridge the idiographic and nomothetic divide are available and would be advantageous to pursue in future work. These include the idiographic filter approach (Nesselrode, Gerstorf, Hardy, & Ram, 2007), which allows for variability in structure across individuals, while also estimating a shared structure. For instance, a model with the same number of factors could be estimated for all, but factor loadings can be allowed to vary across individuals. This type of model, however, requires estimation techniques that proved problematic in this particular set of variables.

Another promising approach is Group Iterative Multiple Model Estimation (GIMME; Gates, Molenaar, Hillary, Ram, & Rovine, 2010). GIMME combines structural equation modeling and vector autoregression to generate directed network models for each individual. Nomothetic and idiographic paths are estimated through an iterative process whereby shared paths are first identified and estimated for all individuals, and then augmented by person-specific paths. Further, if desired GIMME can also be flexibly applied to individuals and dyadic data (Gates & Liu, 2016). For more details and an application to clinical data, see Beltz, Wright, Sprague, and Molenaar (in press) in this issue.

Limitations, Alternative Modeling Approaches, and Future Directions

PDs are ideally suited for study through the lens of interpersonal theory. However, many other psychiatric conditions are defined by impairments in other domains of functioning (e.g., eating, mood, cognition, etc.). The importance of interpersonal functioning for all psychiatric conditions notwithstanding (Pincus & Wright, 2011), the variables used here can be augmented or replaced with different variables suited to the clinical question (e.g., Fisher, 2015; Fisher & Boswell, 2016). Additionally, idiographic items that capture a specific target behavior could be incorporated in clinical settings for a truly tailored assessment. A serious consideration, though, is that many behaviors of clinical interest may be relatively rare in their expression (Wright & Simms, 2016). A good example of this can be seen in Figure 1, where self-harm episodes are rare relative to the fluctuation in the affective and interpersonal behaviors. Therefore, using items reflecting more normative behaviors may be necessary depending on the planned assessment schedule.

Another challenge we faced in fitting our models was that maximum likelihood and robust weighted least squares estimation approaches encountered serious difficulties in producing acceptable solutions. We believe this was due primarily to the distributions that were highly

nonnormal or had low variance, which resulted from the interpersonal variables derived from a checklist of behaviors. Principal axis factoring worked well in this situation, but future work would benefit from greater consideration of indicator distributions. Specifically, using measures that result in more continuous distributions would be preferable (e.g., visual analogue scales). Alternative estimation approaches would also allow for confirmatory models, providing greater investigator control and model-based testing in more than one individual (i.e., via multigroup models).

Additionally, a confirmatory framework would allow for the estimation of more complex models, such as dynamic factor analyses (McArdle, 1982; Molenaar, 1985), which test associations between time-points. We note that it is possible to compute factor scores, as we did here, and then use them in a time series approach or in association with external variables. By taking the factor score estimates, time series analyses can be performed to explore carry-over effects from one situation to the next. At the same time, this would be challenging given that we used an event-contingent design, which results in irregular intervals between assessments, and many time series models assume equivalent spacing. These factor scores also proved useful for predicting high-impact clinical events (e.g., self-harm) and may be valuable as predictors of future events within a machine learning framework.

It is also important to note that the models we estimated here were dynamic *across situations*, but the micro level dynamic processes that occur *within situations* escaped our approach (see, e.g., Hopwood, Thomas, et al., in press). It is very likely that additional processes play out within situations that are clinically important. A final consideration is that we used relatively few indicators within our models, and future work may wish to expand the density of measurement for any given construct to include several indicators in order to establish more determinacy in the factors. We would recommend three to five indicators per construct being assessed. More indicators would allow for greater complexity and nuance in the factors as well as generating more robust factor solutions.

Conclusion

In sum, we used p-technique factor analysis to estimate idiographic dynamic personality structures. These models resulted in situational signatures, which can be mapped on to formulations from several clinical theories of personality and psychopathology (interpersonal theory, attachment, object-relations). It was not surprising that we found individuals diagnosed with BPD to be diverse in their structures given prior results using traditional dispositional assessments. Novel was the demonstration that idiographic structures were associated with sentinel clinical events that are central to BPD and are often the target of intervention (e.g., substance use, aggression toward self and other). We hope that these results, which provide an initial method for assessing dynamic processes, encourage others to consider using this approach in clinical practice and research.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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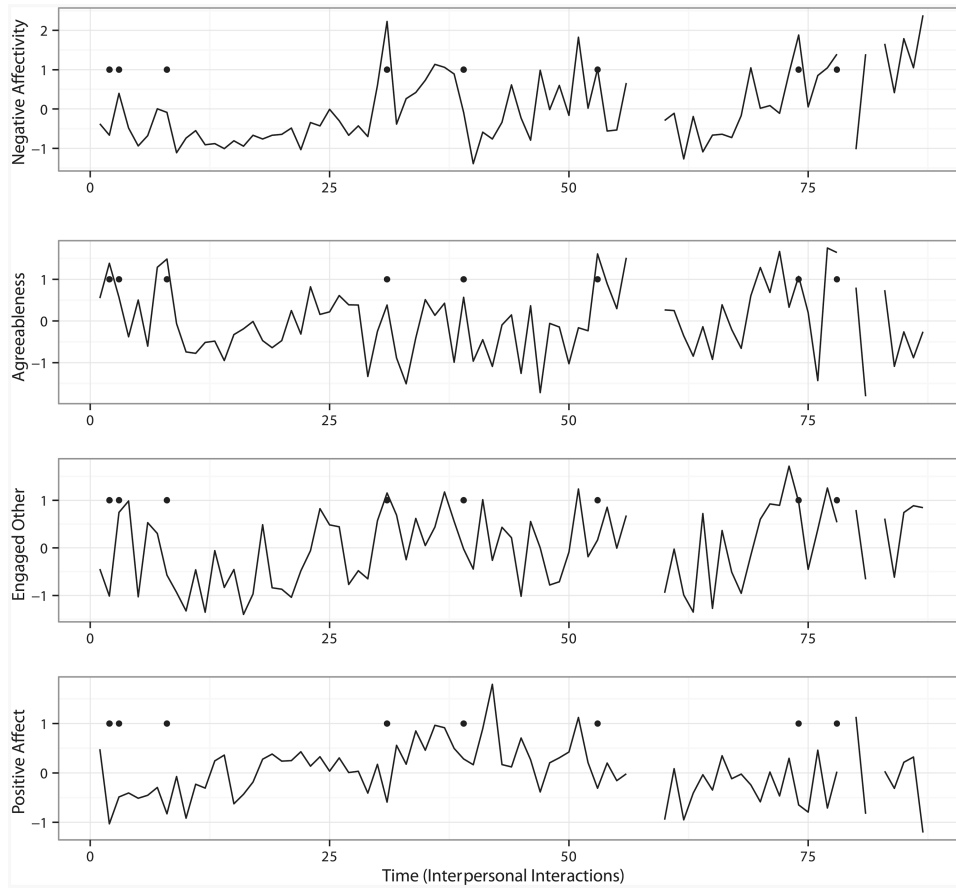


Figure 1. Plot of factor score time series for Participant D.
Note. Solid black lines reflect factor scores calculated by regression method from p-technique factor analysis, solid black points indicate instances of self-harm.

Table 1

Diagnostic Information for Five Exemplar Participants.

Diagnosis	Participant				
	A	B	C	D	E
<i>Personality disorder criteria</i>					
Paranoid	3	2	5	2	1
Schizoid	2	0	3	0	3
Schizotypal	4	2	1	0	1
Antisocial	5	1	2	5	1
Borderline	5	8	5	7	7
Histrionic	4	4	4	0	1
Narcissistic	6	2	3	3	2
Avoidant	4	1	0	5	4
Dependent	0	4	1	5	5
Obsessive-compulsive	3	4	1	0	2
Total criteria count	33	26	20	25	26
<i>Clinical syndromes</i>					
Diagnosis 1	Major depressive	Major depressive	Cannabis use	Major depressive	Major depressive
Diagnosis 2	Binge eating	Cannabis use	Past major depressive	Polysubstance use	Social phobia
Diagnosis 3	Past alcohol use	Panic	Past alcohol use	Agoraphobia	
Diagnosis 4	Past polysubstance use			Social phobia	
Diagnosis 5				Obsessive compulsive	
Diagnosis 6				Past polysubstance use	

Note. Due to space considerations, the word *disorder* is omitted from each clinical syndrome, for example, major depressive = major depressive disorder.

Table 2
Individual p-Technique Factor Loadings and Correlations for Exemplar Participants.

	Participant																
	A			B			C			D			E				
	F1	F2	F3	F1	F2	F3	F1	F2	F3	F1	F2	F3	F1	F2	F3	F4	F5
Self	.14	-.41	.31	-.28	-.43	.12	-.14	-.65	-.06	.17	.02	.05	-.15	-.05	.57		
Affiliation	-.75	-.36	-.07	.79	.03	-.08	.74	.03	.18	-.07	-.03	.61	.03	-.06			
Other	.59	.76	-.01	.23	-.32	.61	.12	-.46	.47	.09	.00	.10	-.27	.53	-.07		
Affiliation	-.56	.90	.08	-.24	.28	.64	-.01	.15	.68	-.01	.03	-.02	.24	.56	.02		
Affect	-.77	.57	-.11	-.36	.39	.01	.11	.11	.02	.44	-.04	-.40	.10	.26	.27		
Anxiety	.75	.21	.87	.63	-.04	-.09	.67	-.08	.09	.98	.01	.10	-.04	.08			
Hostility	.93	-.23	.73	.47	-.49	.04	.72	-.08	-.06	.03	.92	-.02	-.13	.05	-.09		
Guilt	.93	.24	.41	.40	.33	.13	.50	-.14	.16	.06	-.04	.58	.14	.10	.10		
Sadness	.93	-.16	.80	.78	-.04	.01	.72	.20	-.05	.04	.00	.52	-.15	.01	-.01		
Correlations	F2	-.40	-.73	-.11							-.07						
	F3		-.04	.01	.37	-.22					-.20	-.24					
	F4				-.04	.10	.15				.03	-.04	.07				
	F5										-.01	-.09	.25	.04			

Note. F1 = Factor 1; F2 = Factor 2; F3 = Factor 3; F4 = Factor 4; F5 = Factor 5. Factor loadings >|.25| are in bold.