Defining the Mechanisms of Borderline Personality Disorder

John F. Clarkin  Michael Posner
Weill Cornell Medical Center, New York, N.Y., USA

Key Words
Personality disorder · Borderline personality disorder · Temperament · Psychotherapy of borderline personality disorder

Abstract
Understanding the biological connections to mental processes was one of the original goals of psychoanalysis, and the development of cognitive and affective neuroscience and its methods might contribute to actualizing this goal. Personality disorders provide an opportunity to examine the complex mental structures of individuals experiencing extreme difficulties in interacting with their social environment. We provide initial information on a collaboration exploring an approach to one of the most serious personality disorders, borderline personality disorder, based upon the study of normal attention, individual differences in temperament, self definition and attachment organization, with the potential to illuminate the psychology and psychobiology of the disorder and to contribute to psychotherapeutic intervention. This developing model of borderline personality disorder can relate the symptoms to more enduring temperamental aspects of the patients. The goal is to understand the development of neural networks that underlie the abnormalities of adults, and eventually work out the interaction between temperament, genes, and experience that produce the disorder, and potentially inform intervention.

Introduction
Borderline personality disorder (BPD) constitutes one of the most important sources of long-term impairment in both treated and untreated populations [1]. Approximately 11% of psychiatric outpatients and 19% of inpatients meet criteria for BPD [2], the majority of whom are women. A population prevalence of 0.3% for diagnosed definite or probable BPD was found in a nonclinical population using a conservative diagnostic interview [3], and a similar figure (0.7%) was found subsequently in a Norwegian population-based study using a somewhat less conservative interview [4]. Suicidal [5, 6] and self-injurious behavior are particularly prevalent with BPD patients. BPD is substantially comorbid with other personality disorders [7, 8] and with Axis I disorders [9]. BPD negatively affects the treatment efficacy for a number of Axis I disorders [10] and is less responsive to pharmacotherapy [11]. This prevalent, chronic, and debilitating syndrome is associated with high rates of medical and psychiatric utilization of services [12].

Personality disorders represent an opportunity to examine the complex mental structures of people experiencing extreme difficulties in interacting with their social environment. Because of its behavioral complexity and lack of clear organic markers, BPD poses one of the greatest challenges to understanding the psychobiology of its development. BPD is a defined mental health problem that has been identified and studied by psychoanalytic [13] as well as behaviorally oriented therapists [14]. Un-
understanding the biological connections to mental processes was one of the original goals of psychoanalysis, and the rapid development of cognitive and affective neuroscience built on brain imaging methods might help actualize this goal [15, 16a, b]. A unique aspect of our work is the collaboration of a team of researchers with different areas of expertise. With funding from the Borderline Personality Disorder Research Foundation, we assembled a team of neurocognitive scientists (M. P., David Silbersweig), a leading psychoanalyst (Otto Kernberg), experts on attachment style (Kenneth Levy), and psychotherapy researchers (J. C.).

This Special Section provides some initial information on a collaboration exploring an approach to BPD based upon the study of normal attention [17, 18], individual differences in temperament and personality [19, 20] and brain imaging [21, 22], with the potential to illuminate the psychobiology of the disorder and contribute to intervention strategies. In the first section of this overview, we present a discussion of the symptoms of the disorder and the centrality of temperamental aspects of negative affect and poor self-control. We discuss the relationship of these variables to the conception of self and others, and the nature of attachment to others in the environment. We then provide an outline of our research plan and summarize the findings we have obtained so far from borderline patients and appropriate controls prior to their undergoing a year of therapy. This summary places the papers in the Special Section in their context.

BPD Symptomatology

BPD is diagnosed if the individual has any 5 or more of a set of 9 criteria in DSM-IV, Axis II [23], including items relating to identity diffusion, impulsivity, and affect dysregulation. That BPD symptomatology is characterized by several major dimensions of psychopathology has long been established. The empirical clusters or primary dimensions of BPD have been discussed by researchers [24] and clinicians since the seminal multivariate work by Grinker [25]. A burgeoning literature has suggested that impulsivity and negative affectivity/emotional dysregulation are the two core personality traits that characterize much of the phenotypic variation seen in BPD [26–29].

Theoretical literature has only recently begun to address the manner in which these dimensions are linked to major underlying personality or temperamental processes. It is not clear how these processes yield BPD through unspecified interactions among the processes themselves and environmental and developmental inputs. We consider briefly the two major domains of temperament and personality processes with respect to the development of BPD.

Symptomatology and phenomenology of the disorder are a first attempt to isolate individuals with a common condition. In order to understand the nature of BPD, there are many reasons why research must go beyond the symptom level. Symptoms change over time, and have been found to be unstable [30]. This is not surprising, because the criteria set is composed of behaviors, symptoms, traits, and attitudes. Symptoms do not reveal mechanisms of action. Even the motivational level of human behavior is not approached in the symptom/criteria set. In addition, the criteria set does not include many aspects of human functioning that are crucial to an understanding of personality disorder.

Temperament and Personality Organization

The constructs emerging from the field of temperament research may have considerable utility in articulating the causes and emergence of personality disorders, particularly BPD. Within academic psychology and particularly within developmental laboratories, extensive research on temperament and its relationship to biological systems has matured into a rich and powerful corpus. Derived principally from the study of children, the contemporary framework for temperament provides an important organizing scheme for the investigation of the development of personality disorders. In one view, temperament refers to individual differences in motor and emotional reactivity and self-regulation [31]. Temperament arises from genetic endowment [32], but temperamental systems are clearly influenced by the environment and follow a developmental course [33, 34]. The interaction of temperament and environment appears to be central to the development of self-control, emotional control, empathy, and social behavior [31], and one of its outcomes is adult personality and personality pathology. For example, research work using the children’s version of these temperament scales has found that empathy and the development of conscience are related to strong, effortful control mechanisms [35, 36].

Our research on BPD has been guided by a model of temperament as it relates to negative affect, evolving self-control, the internal sense of self and others, and related impact on social behavior. Each of these aspects deserves individual consideration.
Negative Affect and Defective Self-Regulation

Negative affect, especially hostility and aggression, and a paucity of positive affect is an essential aspect in understanding the individual with BPD [37, 38]. Negative affect invades the information processing of the individual [39] and the organization of the individual’s interpersonal and personal experience.

A second central feature of borderline pathology is poor self-regulation. This relative inability to self-regulate is manifested in impulsive behaviors, including impulsive self-destructive behaviors, and difficulties in modulating affective experience. Impulsivity and/or impulsive aggression are considered to be underlying dimensions in BPD [28, 40, 41].

Impulsivity best predicts the persistence of borderline psychopathology across time [41]. Impulsivity combined with other factors has been related to suicidal behavior in BPD patients. For example, impulsive actions, comorbid antisocial personality disorder and depression are related to a history of suicidal behavior in BPD patients [42] and other mixed personality disorder groups [43].

There is evidence of the link between impulsivity and underlying biological systems. Both impulsive aggression and affective instability show a stronger familial relationship than the diagnosis of BPD itself [44]. In twins, impulsivity and affective instability are heritable [45, 46]. Biological, neuroendocrine and imaging studies provide evidence for the involvement of serotonergic activity in impulsive aggression [26, 47, 48].

Affect dysregulation or emotional instability has been described as involving unpredictable responses to stimuli, increased baseline lability, unusual intensity of responses and unusual responses [49], all characteristics of a poorly constrained biobehavioral regulatory system [50]. Patients with affective disorders have dysregulation of positive affectivity [51, 52] whereas BPD patients have dysregulation of negative affect [49].

The evolution of self-regulation in the developing child – the antidote to aggression, impulsivity, and affect dysregulation – is a central issue in understanding both the development of normal personality and its organization and personality pathology [31]. Studies suggest that effortful control has a developmental course in which some children by age 3 are capable of efficiently making choices in conflict situations, especially those involving the suppression of dominant response modes.

Identity Diffusion

There is a general recognition that the developing individual evolves a sense of self that, in turn, influences information processing and reactions to the environment. Influenced by temperamental disposition and environmental events (sometimes traumatic), a secondary level of intrapsychic organization takes place that determines the clinical syndrome of identity diffusion [13] reflected in the DSM-IV diagnostic criteria for BPD. Identity diffusion is characterized by a lack of integration of the concept of self and significant others. These poorly integrated conceptions of self and others are derived from an excessive dissociation between positive and negative affective investment of self and other representations, leading to chronic deficiency in the assessment of self and self-motivations. The clinical characteristics of BPD show chronic, severe pathology of object relations and immaturity in judgments of emotional relationships, difficulties in the commitment to work or to a profession, difficulties in the commitment to intimate relations and disturbances in sexual and love life. Imaging results have proved an anatomical connection between mechanisms of self-regulation and self-referential processes in the midfrontal cortex [53].

Attachment

Recently, clinical researchers and theorists have understood fundamental aspects of BPD such as unstable, intense interpersonal relationships, feelings of emptiness, bursts of rage, chronic fears of abandonment and intolerance for aloneness, as stemming from impairments in the underlying attachment organization [54–56]. The dependent and vulnerable infant’s experience of the relationship with the caregiver has been hypothesized to lead to the development of representations of self and others [57–59]. This experience between infant and caregiver is potentially influenced by many factors, including the temperament of the child and the nature of the caregiver’s attention and nurturing. Samples of borderline patients show high incidence of early abuse [60], prolonged separations from caregivers during childhood [61] and neglect [62]. These experiences would make the development of insecure internal working models of attachments in borderline patients quite plausible.

Representations of self and others and strategies for processing attachment-related thoughts and feelings can predispose the individual to psychopathologies such as that found in BPD. An expectation of caregiver rejection or undependability could lead to a conceptualization of self as bad and unlovable, and conceptualization of others as rejecting. Infants who develop internal working models of insecure attachments to others may minimize or maximize attachment needs [63]. Borderline patients are
characterized by insecure attachments, but this can take the form of dismissive or preoccupied states of mind [55]. Patients rated as preoccupied on the Adult Attachment Interview (AAI) were less likely to show significant change after one year of psychotherapy and had a higher drop-out rate than patients rated as dismissing. In addition, borderline patients with relatively higher reflective functioning (an ability to evoke feelings, beliefs, intentions and other psychological states in their account of relationship experiences) as measured from the AAI [64] narratives fare better in treatment than those with low reflective functioning.

**A Working Model of Borderline Personality Disorder**

Our working model of BPD, therefore, posits a dynamic interaction of temperament, especially a preponderance of negative affect over positive affect, low effortful control, and an absence of a coherent sense of self and others, in the context of a non-secure, anxious attachment style [65a]. Our working model has many similarities to those of others [65b, 66]. What is unique about our work is the measurement of temperament, related investigation of neurocognitive mechanisms of attention, orienting, and conflict resolution, and measurement of identity diffusion and attachment style. These concepts are becoming increasingly connected to particular brain circuits and thus allow us to predict changes in brain imaging studies that might occur with various forms of therapy.

In this process of developing a model, we are attempting to use these key concepts in active challenges to the BPD patient in order to understand how they function in the immediate present. An information processing system that is actively influenced by negative affect, faulty and ineffective conflict resolution, and expectations of attachment to others in an anxious, ambivalent way specifies the BPD experience, but also makes the issue of treatment foci and treatment development more specific and attainable. This suggests that interventions focused on the information-processing system, especially in the social interpersonal sphere, will have the most impact on the patient, and is a necessary target of change if symptom improvement is to be maintained across time.

We think that adverse environmental events, such as sexual abuse, physical abuse and neglect, should be seen in the context of the basic information processing of the individual. It is plausible that these traumatic events add further stress to an already vulnerable individual. We do not assume that a temperamental disposition of negative affect and poor effortful control will, of necessity, result in BPD. Rather, it is assumed that if these temperamental dispositions meet with an environment involving early separations as well as physical and/or sexual abuse, parental neglect can lead to identity diffusion and impulsive, self-destructive behavior. We note that other neurobehavioral systems could also interact with the basic high negative affect/low control (constraint) to potentiate the expression of a BPD-prone temperament.

It is possible that attentional training accomplished at the time of development of the executive system might help a broad range of children to overcome the deficits involved in development with this inadequate self-regulation. Although the chances that this will be effective in overcoming the dramatic deficits of BPD do not seem very great, it is important that our understanding of the nature of the disorder and its development leads to a consideration of that possibility.

**Research Plan and Subsequent Findings**

**Temperament**

Our research plan flows from the hypothesized conceptualization of the nature of BPD, enunciated above. Since the symptoms of BPD include dysregulation of negative emotions particularly in interpersonal relations, we hypothesized that borderline patients would be high in negative affect and low in effortful control as measured by common temperament and personality scales. The Adult Temperament Questionnaire (ATQ) [32] was utilized because it has scales for negative affect and effortful control, and because it was based upon measures that had been widely used for young children. A temperament high in negative emotionality, including anger, and low in effortful control would appear to provide the basis for poor interpersonal relations, thus producing another of the central difficulties in BPD.

The data we have reported [67a] suggest that patients with BPD are higher than normal persons in their self-described negative affect and lower in their self-described ability to control emotions and behavior (effortful control). As expected, the patients showed quite high levels of negative affect, well above the average, and were also somewhat lower than normal on effortful control. Their scores in these temperamental dimensions did not differ depending on their medication status.

We screened over 1,000 university students who were administered the ATQ. Of primary interest were the factors of negative affect and of effortful control. We selected two groups of controls. The temperamentally matched control group was selected to show a similar temperamen-
tal profile to the borderline patients, i.e., high negative affect and low effortful control. We also selected average controls whose scores on negative affect and effortful control were close to the middle scale score of 4 on both of these variables. All control subjects were screened for personality disorders and did not meet criteria for BPD. While the majority of temperamentally matched controls did not have a personality disorder, in our efforts to recruit them for experimental and brain imaging sessions we noted the difficulty in working with some members of this population due to frequent changes of address and phone number, unreliability in keeping appointments, and/or their heightened anxiety and paranoia regarding experimental procedures. Our general perception was that these were rather difficult people whose behavior seemed to show evidence of dysregulation, even though they were functioning in an academic setting and did not meet criterion for BPD. As described in the paper by Hoermann et al. [67b], we examined the clusters of borderline patients formed by a consideration of varying degrees of effortful control. Once the patients were empirically grouped by the effortful-control construct, we examined hypothesized differences between the groups in terms of symptoms, interpersonal behavior, and self-conception or identity diffusion. These findings may have implications for which treatment an individual should receive, and/or how the treatment must be delivered to result in clinical response.

Attention Network Task

The next step was to examine whether consistent patterns of performance on psychological tests would emerge both from the diagnosed population and from the temperamentally matched group, while a different pattern would emerge from the average controls. Experimental procedures known to tap effortful control were used. It would also be important to study the interaction of attentional control and negative emotionality in a task designed to assess the ability to control responses in the face of negative input. If patients differed from both control groups, we would expect the functions on which they differed to provide a basis for hypotheses about the pathophysiology of the disorder. If the patients and the temperamentally matched controls showed a similar pattern but those two groups differed from average controls, we would posit that borderline personality disorder arises from socialization of a particular type of temperamental pattern.

Subjects were given the Attention Network Test (ANT) [68a] to provide an evaluation of the efficiency in three aspects of attention: alerting, orienting and conflict resolution. The network scores have proven reliable and show considerable independence across subjects. The ANT is described in the paper by Fertuck et al. [68b].

We found that patients differed from the average and temperamentally matched controls in the conflict network, but not in any other attentional network, nor in overall reaction time or error rate [67]. In subsequent analyses, patients differed from average controls but not from temperamentally matched controls. The direction of the differences is for temperamentally matched control subjects to have a larger conflict score than the average controls; however, they did not show significant differences from either the average controls nor from the patients. We evaluated whether the difference between patients and controls could be explained by differences in age, medication, or temperament, and we concluded that the difference between patients and average controls could not be explained by age or medication.

As described by Fertuck et al. in this Special Section, we have found that when borderline patients are examined not in contrast to controls but as compared to each other, borderline patients differ not only on the ANT task but also in selected neurocognitive tasks that assess executive control.

These results indicate two important findings about the BPD patients. First, there is a particular abnormality in the functioning of the attentional network specifically involved in control of conflict. The other two components of the attentional system (alerting and orienting) do not seem to be impaired in these patients relative to controls. Second, the abnormality is present in BPD patients but not in the temperamentally controls. Although the temperamentally controls also show elevated conflict scores, they do not differ significantly from average controls. We conclude that temperament may play a role in the disorder, possibly in predisposing individuals to develop BPD, but some other factors must be involved, such as the formation of identity diffusion and severe environmental stressors.

Conceptualization of Interpersonal Relations

In yet another attempt to understand the heterogeneity of BPD pathology, especially as it relates to interpersonal behavior and interpersonal connectedness, Levy et al. [68c] describe the BPD patients in terms of their attachment styles. In the developmental literature, there is evidence that the infant learns effortful control through the attachment and attention of a caregiver who models soothing and self-control in high-affect-laden situations.
We have, therefore, provided a measure of the borderline patients’ internal working model of attachments. This attachment style may relate to effortful control, and to the nature of the interaction between patient and therapist in treatment.

**Treatment**

Psychotherapy is the recommended primary technique for treating BPD patients [69] and is the most widely practiced approach to their treatment. A recent meta-analysis [70] suggests that psychotherapy is an effective treatment and may be associated with up to a sevenfold faster rate of recovery in comparison with the natural history of the personality disorders. While these findings are encouraging, few controlled studies have actually examined the efficacy of particular treatments for BPD patients.

In contrast to the extensive use of psychotherapy, only two treatments – psychodynamic treatment and dialectical-behavioral therapy (DBT) – have shown acute efficacy for treating BPD [71, 72]. The Linehan [72] study examined outpatient psychotherapy for BPD patients, but only for the subgroup that exhibited suicidal behavior. Compared to the treatment usually given in the community, DBT led to a reduction in the number and severity of suicide attempts and a decrease in the length of inpatient admissions.

Among several other common and promising treatment approaches to BPD is the object relations approach based on Kernberg’s clinical theorizing [37]. Kernberg et al. [73] call this treatment Transference-Focused Psychotherapy (TFP) because it relies principally on the techniques of clarification, confrontation and interpretation within the evolving transference relationship between the patient and the therapist. Although Kernberg’s techniques are widely practiced in treating BPD, there has been little research concerning the effectiveness and efficacy of these techniques.

Treatment planning, either for clinical research or clinical practice, cannot be done solely on the basis of the DSM-IV criteria that constitute the diagnosis. It is becoming clear that these criteria and diagnostic membership change with time. The characteristics of these patients such as temperament, effortful control, attachment style, and neurocognitive functioning, will either affect the treatment or be targets for treatment. The following are specific ways these variables might influence treatment.

**Process of Interaction between Patient and Therapist.**

The interaction between the patient and therapist can be seen as a secondary element which must be managed so that the patient learns skills, or it can be seen as a primary vehicle for change in interpersonal behavior by the patient. All treatments are aware of the interaction between patient and therapist, but different therapy orientations put varying degrees of emphasis on the role of the interaction and thus varying degrees of training of therapists. We think future studies of therapy process between patient and therapist will reveal differences between borderline patients and between therapy types in terms of that process, whether it is used for therapeutic leverage, and to what extent the therapy process changes over time. The current issue and its data provide some interesting hypotheses that could be examined in process studies.

**Neurocognitive Impediments to Treatment.**

Neurocognitive processes, both those involving affect and those without affect (conflict resolution on the ANT) can be seen as targets for intervention or as deficits to which the treatment must be adapted for the patient to improve.

**Emotion Processing.**

The borderline patient is characterized by labile moods, expression of negative affect (especially aggression), and experiences affect storms either in isolation or in interaction with others. The information presented here in terms of assessment of negative affect and poor effortful control are questionnaire methods of assessing affect dysregulation. Treatment would have as one of its goals the enhancement of emotional regulation, with more modulation and control of anger and other negative affects.

**Sense of Self and Others.**

The patients’ sense of self and others is central to their interaction with others in the environment and central to their interaction with the therapist in the treatment itself. The treatment situation is an opportunity to examine in detail the interaction of the patient with others that is so central to the deficits in social and work relations which brought the patient to treatment initially. If the sense of self and others is infused with hostility, defective and out of congruence with how others perceive the patient, the therapy relationship is an opportunity for corrective perception.

In the treatment study currently being conducted by our research group, borderline patients are randomly assigned to one of three treatment groups in a double-blind design. One group receives a manualized psychoanalytically oriented treatment [73]. A second group receives a cognitive behavioral treatment [14] and a third group receives the pharmacological and counseling treatments common in the community. Changes that might take place in self-reported temperamental dimensions of negative affect and effortful control will be examined following therapy. Since these assays involve reports of...
recent experiences, it is possible that these will be influenced by the therapies. The brain scans to be carried out after the therapy will show if the stronger activation of the amygdala found in patients compared to average controls prior to therapy will be reduced with therapy.

It will also be important to see if executive attention is influenced by the therapeutic interventions. If amygdala activation is reduced in patients, it will also seem likely that control systems related to emotion would be affected. However, since the ANT does not involve any emotional system, it will be interesting to see if therapy generalizes to this form of cognitive control.

A preliminary analysis after 4 months of therapy was made in all patients who had reached this point, but without breaking the code describing which therapy was involved. It was apparent that there was significant symptom improvement. The degree of improvement was influenced by the initial severity but also by the strength of effortful control as reported by the patients prior to entering therapy.

In summary, we are developing a model of BPD that can relate the symptoms to more enduring temperamental aspects of the patients. We hope to understand the development of the neural networks that underlie the abnormalities found in adults and eventually work out the interaction between temperament, genes and experience that produce the disorder. This special section provides our latest findings on effortful control in borderline, correlates of the attention network difficulties in these patients, and further information on the attachment style patterns in borderline. We are hopeful that as the model is refined with further data collection, it will indicate important areas of borderline patient heterogeneity and direct future treatment development.

References
