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MENTAL REPRESENTATIONS, SOCIAL EXCLUSION, AND
NEUROBIOLOGICAL PROCESSES IN BORDERLINE PERSONALITY DISORDER:
A MULTI-LEVEL STUDY

By Jeffrey Kendall Erbe

A dissertation submitted to the Graduate Faculty in Clinical Psychology in partial
fulfillment of the requirements for the degree of Doctor of Philosophy.
The City University of New York

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This manuscript has been read and accepted by the Graduate Faculty
in Psychology in satisfaction of the dissertation requirement
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ABSTRACT

MENTAL REPRESENTATIONS, SOCIAL EXCLUSION, AND NEUROBIOLOGICAL PROCESSES IN BORDERLINE PERSONALITY DISORDER: A MULTI-LEVEL STUDY¹

By

Jeffrey Kendall Erbe

Advisors: Eric Fertuck, Ph.D. and Diana Diamond, Ph.D.

Borderline Personality Disorder (BPD) is an ongoing public health crisis. Poor developmental quality of differentiation-relatedness of object representations and attachment insecurity have been clinically and empirically demonstrated as core patterns of intrapsychic and interpersonal dysfunction in this particular form of personality pathology. Differentiation-relatedness (D-R), which involves a complementary relationship between intrapsychic autonomy and interpersonal relatedness, has been shown to be a significant aspect of internal psychic experience that relates directly to external relationship patterns, including characteristic response to interpersonal interactions and has been a specific target for treatment of BPD. Specifically, individuals with BPD have shown lower developmental quality of differentiation-relatedness than non-clinical controls. Similarly, attachment insecurity, stemming from repetitive, conflicted exchanges with caregivers beginning from early development, is a hallmark of borderline personality. Although differentiation-relatedness and attachment organization have been extensively studied in this clinical population, few studies have investigated the relationship between such measures of historically relevant intrapsychic functioning, behavioral and neural responses to social interaction in the here and now. Through narrative responses to a clinical

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interview, self-reports and a measure of social cognition during fMRI that operationalize borderline pathology in distinct ways, this study investigated differences between individuals diagnosed with BPD and non-clinical controls, as well as the relationship among measures of developmental quality of differentiation-relatedness of object representations, attachment style, and behavioral and neural response patterns in a laboratory-based design.

Results: Independent samples t-tests showed significant differences between borderline patients and controls for D-R mean, father, and self scores, attachment anxiety and avoidance, and anger response patterns to experiences of social exclusion. Simple linear regression analyses demonstrated that D-R mean, father, and self scores also significantly predicted anger response in Cyberball. Non-significant positive trends for attachment anxiety, scored from the self-report Experience in Close Relationships (ECR) measure, predicting rejection and anger were also evident; however the ECR was less sensitive at predicting rejection and anger in response to social exclusion than D-R scores. The D-R mean score also modulated neural activity associated with social inclusion in Cyberball in the left inferior frontal cortex. Thus, this study provides further evidence of the multidimensional nature of borderline personality disorder and the intricate complexity of the relationship among different levels of the pathology (i.e., intrapsychic, attachment, behavioral, and neural). These results, in conjunction with further studies on the relationship among these components, have the potential to offer crucial insights for the treatment of this disorder.

Keywords: Borderline Personality Disorder, Object Relations Inventory, social exclusion, Cyberball, fMRI, social cognitive neuroscience

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*I dedicate this dissertation to Kelly and
in fond memory of Dr. Sid Blatt, a true pioneer.*

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CHAPTER I

Introduction

Borderline personality disorder (BPD; DSMIV-TR, American Psychiatric Association, 2000) is a prevalent, high-risk disorder that has devastating health consequences. Between 1-2% of adults meet diagnostic criteria for BPD (M. F. Lenzenweger, Lane, Loranger, & Kessler, 2007), though one report estimates a 5.9% lifetime prevalence of the disorder (Grant et al., 2008). Non-remitting BPD is associated with elevated rates of chronic physical health syndromes and medical hospitalization (Frankenburg & Zanarini, 2004). Consequently, the diagnosis is associated with one of the highest rates of health service utilization (Bender et al., 2001) and therefore poses significant public health risks (Gunderson, 2009).

Despite known health costs, the relationship between underlying intrapsychic, social cognitive, and neural substrates of BPD has not been adequately investigated. To do so requires a complex, clinically relevant laboratory approach. Investigations within the framework of social cognitive neuroscience (SCN; Adolphs, 2003a; M. D. Lieberman, 2007; Ochsner & Lieberman, 2001) provide a sophisticated scientific framework for studying BPD. Although such research has begun to illuminate the neural and behavioral sequelae of interpersonal dysfunction in patients with the disorder, clinically relevant methods of measuring internalized object representations and attachment style have not been incorporated into the designs of these studies. Thus little is known about the impact of mental representations on the unique behavioral patterns and biological constitution of the disorder. If psychoanalytic models of the intrapsychic and interpersonal dynamics of borderline pathology are applied to the findings of social cognitive neuroscience on the

neural correlates of BPD it will be possible to address the interactions between multiple levels of borderline pathology. Most importantly, this multifaceted investigation of the representational, interpersonal, and neurobiological correlates of BPD may eventually enhance our understanding of the mechanisms of change in treatments of BPD.

The literature review that follows features clinical theory and research pertaining to the different levels of borderline pathology. First, BPD is introduced as a psychopathology that has received increasing attention, due to the complicated nature of its treatment and taxation on the mental health system. Next, the second section provides an account of psychoanalytic object relations and attachment theories as they apply to borderline pathogenesis. The third section offers a review and discussion of the social cognition literature as it relates to individuals with BPD, with a focus on interpersonal sensitivity and idiosyncrasies of social perception. In the fourth section the social cognitive neuroscience approach is explained along with a review of social exclusion and its related construct of rejection sensitivity. The fifth section integrates themes from previous sections in order to clarify the multi-level approach that is used in the present study. Finally, the sixth section presents research questions and hypotheses aimed at establishing clearer relationships between these levels of investigation.

CHAPTER II

Literature Review

2.1. Evolution of the Borderline Disorder

The history of borderline pathology began with clinical observations dating back to the early nineteenth century. Psychiatrists documented cases that did not conform to the classic dichotomy of neurosis and psychosis but, rather, these were patients who exhibited aspects of both and therefore defied traditional categorization (Lombroso & Hoepli, 1876; Pinel, 1801; Prichard, 1835). Rosse (1890) was the first to use the term in describing “borderline insanity”. Falret (1890) offered a portrayal that is strikingly similar to contemporary diagnostic criteria; his patients displayed labile affect, impulsivity, contradictoriness, and splitting defenses, which Klein (1946) and Kernberg (1975) later argued to be the distinctive feature of borderline-organized defense. It was not until Robert Knight’s (1953) contribution, however, that borderline became recognized as a pathological condition of *personality*. His account moved away from depictions of fleeting states of decomposition to a character defined by sustained ego weakness and primitive defenses. This established a basis for understanding borderline pathology as an enduring personality structure.

Otto Kernberg was the first to synthesize the clinical literature on borderline pathology and his formulation bore some similarity to that of Knight. Like Knight, he conceptualized it as a personality organization characterized by distinct ego deficits (the severity of which was between that of neurosis and psychosis) and primitive defenses (e.g., splitting), but he uniquely emphasized the presence of entrenched polarized primitive affects, namely negative affects like anger and aggression (see 2.2.1. Borderline

Object Relations and Attachment Patterns; Kernberg, 1967, 1975). This work was also influenced by theoretical contributions from ego psychologists working in the United States and the British object relations school of psychoanalysis, with its focus on early developmental factors.

Empirical efforts to learn more about borderline personality multiplied from this point forward. Borderline personality became formalized as a disorder (Grinker, Werble, & Drye, 1968) and was eventually included in the *Diagnostic and Statistical Manual* (DSM; American Psychiatric Association, 1980; 1994), which has since become the authoritative volume on psychiatric disorders. Criteria for the diagnosis have been explicated and the extent of the disorder's impact has been widely publicized.

The current consensus is that individuals with borderline personality disorder (BPD; DSMIV-TR, American Psychiatric Association, 2000) typically exhibit disturbed relationship patterns, identity diffusion, emotional instability and impulsive aggression, and are prone to potentially lethal self-harm (J.F. Clarkin, Hull, & Hurt, 1993; Sanislow, Grilo, & McGlashan, 2000). It is a prevalent, high-risk disorder with devastating health consequences. Between 1-2% of adults meet diagnostic criteria for BPD (M. F. Lenzenweger et al., 2007), though another report estimates a 5.9% lifetime prevalence of the disorder (Grant et al., 2008). In the psychiatric population, studies have reported 10-15% prevalence of BPD among outpatients and 20% among inpatients (M.F. Lenzenweger, Loranger, Korfine, & Neff, 1997; Paris, 1999; Weissman, 1993). Non-remitting BPD is associated with elevated rates of chronic physical health syndromes and medical hospitalization (Frankenburg & Zanarini, 2004). Consequently, the diagnosis is

associated with one of the highest rates of health service utilization (Bender et al., 2001) and therefore poses significant public health risks (Gunderson, 2009).

Borderline personality disorder has been studied from several perspectives. In psychoanalytic clinical theories it has been important to elucidate developmental aspects—specific to each patient’s history—of the disorder that become internalized as mental object representations. Object relations accounts of borderline pathology have developed alongside attachment formulations regarding early relationships. Though the attachment work is grounded in observation of infant-caregiver behavior, the lessons from these studies bear on the object relations perspective on BPD and vice versa.

2.2. Object Relations and Development

Kernberg developed a theory of object relations that details the intrapsychic ramifications of infant-caregiver interactions. Over time, he argues, the child’s internalization of experiences with primary caregivers leads to the formation of mental representations, which include representations of internal objects (O. Kernberg, 2004; O. F. Kernberg, 1975). These internal objects are representations of both self and other *and* the dynamic affect that links them. Through repeated interactions, internal self and other representations become consolidated in the child’s mind as an object relational dyad. Consolidation of representations has the effect of structuring the psyche and is thus stable over time, although present experiences can also influence this internal structure (J.F. Clarkin, Lenzenweger, Yeomans, Levy, & Kernberg, 2007).

Bowlby, who was influenced by object relations clinical theory, proposed that early interactions between an infant and caregiver are formative for the infant's future behavior as an adult. Indeed, empirical research from the past several decades has supported his original claim (Van IJzendoorn, 1995). Over the course of development these interactions occur repeatedly. These interactions, particularly those that occur under conditions of peak affect, are stored in memory and result in the establishment of an attachment bond with the primary caregiver(s). This process establishes an *internal working model* for the infant (Bowlby, 1969, 1973, 1990). Internal working model was defined as a relatively stable prototype of interpersonal relations that is activated in countless interpersonal exchanges throughout life. Empirically, these models have translated into discernable attachment styles. That is, one may be *securely* or *insecurely* attached. Insecure attachment is further divided into *anxious* and *avoidant* dimensions (Brennan, Clark, & Shaver, 1998).

The conception Bowlby offered emphasized observable behavior between infant and caregiver and its relation to the infant's future behavior as an adult. Although he and his colleagues recognized the importance of internal factors in addition to external behavior (Main, Kaplan, & Cassidy, 1985), the attachment model has done less to address clinically relevant aspects of the infant-caregiver relationship: namely, the subjective experience that corresponds to such relationships. Psychoanalytic theory has complimented the attachment perspective by concentrating on the psychic consequences of early attachment relationships.

Unlike attachment theorists, object relationalists have long emphasized the role of affect (more than observable social behavior) as the mediary between self and other

representations. This followed from Klein's (Klein, 1940, 1946) assertion that affects are the currency of intrapsychic life. She observed that they are either positive (e.g., pleasurable, idealized) or negative (e.g., unpleasurable, persecutory). Healthy development requires that positive and negative affects coexist for the same object. It is important that this is achieved in development because object relational dyads become sources of motivation and behavior and therefore influence subsequent relationships (J.F. Clarkin et al., 2007). In sum, object representations are internalized, prototypical dyadic relations—mediated by affect—that reflect primary social relationships. They significantly influence interpersonal experiences and are the material of unconscious conflict (O. Kernberg, 2004).

Like Bowlby's internal working models, object representations are internalized aspects of primary early relationships, but they are also constitutive of the subject's personality. Many clinical theorists have agreed that internalized representations contribute to identity development and consolidation (S.J. Blatt, 1974, 1990; S.J. Blatt, Wild, & Ritzler, 1975; Mahler, Pine, & Bergman, 1975; Sandler & Rosenblatt, 1962; Stern, 1985), formation of interpersonal patterns, and subjective meaning (Ainsworth, 1985a, 1985b; Bowlby, 1988; Main et al., 1985). This demonstrates that personality structure constituted by object representations influences an individual's subjective experience and behavior in interpersonal encounters. It is crucial to also note that these representations reflect an internalized history of object relations that bear on behavioral responses to the present environment. This is how psychoanalytic efforts have reconciled internal experience with external attachment behavior and thereby contributed a clinically relevant elaboration of the internal working model paradigm from attachment theory.

2.2.1. Borderline Object Relations and Attachment Patterns

Consolidation and integration of polarized (i.e., positive and negative) affects is an important developmental antecedent to identity formation and eventual differentiation and separation from the caregiver. The capacity to tolerate and regulate affect is gained through secure attachment experiences with caregivers and significant others that are consistent, reliable, and benign. Over the course of development, these experiences translate into object constancy and identity formation, vital elements of psychic structure. Borderline patients, on the other hand, encounter problems in most aspects of this trajectory.

There is considerable agreement that the two primary characteristics of patients with borderline personality disorder are: (1) identity problems and (2) chronic dysfunction in relationships (Livesley, 2001; Pincus, 2005). Both relate to disturbance in early object relations that gradually become reinforced by primitive defenses and incorporated into the borderline patient's personality via internalized representations. Primitive defenses include projection, devaluation, idealization, and projective identification, but the hallmark defense mechanism that manifests in borderline personality disorder is *splitting* (Caligor, Diamond, Yeomans, & Kernberg, 2009; O. Kernberg, 1984; M.F. Lenzenweger, Clarkin, Kernberg, & Foelsch, 2001). Given the fundamental and complex nature of this defense, further explanation of the concept is warranted.

It is argued that borderline patients are constitutionally predisposed to affect dysregulation (J.F. Clarkin, Yeomans, & Kernberg, 2006) that is not adequately contained by the caregiver (Fonagy & Luyten, 2009). Vulnerable to being easily

overwhelmed by intense affect, the subject is obligated to maintain the segregation of positive and negative affects as the only means of tolerating them. Splitting becomes a characteristic defensive response to interpersonal distress in order to preserve the relationship with the other, but unfortunately instead of preserving the relationship it proves maladaptive.

Splitting causes instability of object representations because of the developmental failure to integrate objects charged with polarized affect. It therefore prevents stable, cohesive object representations. The result is *identity diffusion*, defined by fragmented internalized objects and weak ego boundaries (Kernberg, 1975). Identity diffusion reflects the underlying pathological psychic structure and is evidenced by the tormented presentation of many of these patients. Clarkin and his colleagues (2007) describe the clinical consequences:

On a clinical level, the lack of integration of these positive and negative internal representations of self and others is seen in the patient's nonreflective, contradictory, and chaotic descriptions of self and others, and in the striking inability to become aware of these contradictions, with a consequent inability to resolve them (p. 478).

Not only are borderline individuals fraught by unstable relationships, they typically lack the more developmentally advanced reflective tools to address their interpersonal problems. For example, the capacity for mentalization, the ability to think about behavior of the self and others in terms of intentional mental states, is impaired in patients with BPD (Fonagy et al., 1996).

To better account for the chronic dysfunction in the relationships of borderline patients it is important to also understand how their attachment relationships typically fail their developmental needs. Secure attachment facilitates the requisite cognitive and emotional capacities to integrate disparate, affectively charged aspects of the object and

tolerate the genuine complexity of object representations, whereas insecure and disorganized attachment patterns impede this process in various ways. In a review of 13 empirical studies on attachment and BPD, the authors concluded that across the studies, borderline patients were typically rated unresolved with preoccupied features and fearful of rejection in close relationships (Agrawal, Gunderson, Holmes, & Lyons-Ruth, 2004). These attachment patterns are included in the broader categories of insecure and disorganized attachment, which account for many aspects of pathological interpersonal functioning in BPD. For example, the inconsistency in interpersonal encounters with such caregivers contributes to the development of the splitting defense and eventual identity diffusion. Consequently these patients are more dependent on external objects and thus fearful of abandonment and prone to projection and aggression. Therefore, developing the capacity to differentiate from the other and improve mentalization are important aims of treatment for the disorder.

The focus of Kernberg and his colleagues on object relational dyads arises from their clinical attunement to the internal worlds of their borderline patients. Despite sharing a common diagnosis, each patient reflects an internalized history that is unique, nonreplicable. Nevertheless, certain features or patterns of the borderline pathology inscribe themselves in the way these patients describe others and themselves. Given the relevance and import of these clinical observations, it is imperative to pursue the measurement and assessment of the quality of internalized object representations and attachment styles using experimental tools.

2.2.2. Object Relations Inventory (ORI)

As the child matures, reciprocity between a differentiated and integrated sense of self and empathic attunement to significant others emerges as a central dynamic in development (S.J. Blatt & Blass, 1990; S.J. Blatt & Shichman, 1983; Miller, 1984; Stern, 1985). In other words, differentiation and relatedness may be understood as interactive polarities in an unfolding developmental process (S.J. Blatt & Blass, 1990, 1996; S.J. Blatt & Shichman, 1983; D. Diamond, Blatt, S.J., Stayner, D.A., Kaslow, N., 1993a; Diamond, Blatt, Stayner, & Kaslow, 1993b; Sander, 1983).

Psychodynamic researchers have shown that the quality of internalized object representations can be assessed from descriptions of self and significant others (e.g., parents, romantic partner). The Object Relations Inventory (ORI; S. Blatt, Chevron, Quinlan, Schaffer, & Wein, 1988; S.J. Blatt, Wein, Chevron, & Quinlan, 1979) elicits these representations from brief questions that invite participants to provide a spontaneous narrative regarding several important figures in their life. Patients with BPD produce descriptions of others that lack differentiation and cognitive complexity, as compared to descriptions from non-clinical controls (Marziali & Oleniuk, 1990).

Using the differentiation-relatedness (D-R) scale (see Appendix A), Diamond and colleagues (1999) examined two clinical cases of borderline personality disorder, both of whose differentiation-relatedness profiles reflected polarization and splitting. After a year of Transference-Focused Psychotherapy (TFP), responses of one of the patients on the ORI demonstrated increased differentiation and relatedness in representations of self and significant others. This illustrates both the clinical utility of the measure and its sensitivity to the developmental quality of object representations.

Investigations have also shown that the ORI is a valid and reliable method of assessing changes in object relations and interpersonal functioning over the course of psychodynamic treatment (S.J. Blatt & Auerbach, 2001; S.J. Blatt, Auerbach, & Aryan, 1998; S.J. Blatt, Stayner, Auerbach, & Behrends, 1996; Vermote & Lowyck, 2009). Specifically, both increased structural complexity of object descriptions and D-R are strongly correlated with clinical improvement (S.J. Blatt, Wiseman, Prince-Gibson, & Gatt, 1991; Gruen & Blatt, 1990; Vermote, 2005; Vermote et al., 2010).

In one example, Vermote (2005) assessed differentiation-relatedness in a sample of patients who participated in a 9-month psychodynamic inpatient treatment program. He reported that their D-R scores progressed from admission levels that reflect polarization and splitting (D-R = 4.84) to levels midway between polarization and the emergence of object constancy (D-R = 5.44) at the end of treatment. Furthermore, he discovered sustained increases at long-term follow-up (D-R = 5.65). These results demonstrate that changes in quality of the internal world, which are influenced by treatment, are reflected by this measure. It is estimated that both the conceptual level (S. Blatt et al., 1988) and D-R scales, derived from narrative accounts of individuals' early attachment relationships and experiences, constitute one layer of conceptualization from which to understand the disorder.

Over the past few decades, clinical theorists and empirical researchers have generated a formidable body of knowledge about BPD. Object relations and attachment theories have enhanced our understanding of the intrapsychic phenomena that manifest in patients with BPD. Research in these areas has afforded the measurement of the developmental quality of differentiation-relatedness as it manifests in oral descriptions of

self and significant others and relevant attachment styles through the use of self-report measures. An important question remains: how do these internalized object representations and attachment styles impact the present experience of interpersonal encounters? According to object relations and attachment theories, internalized representations influence current behavior and it is possible to analyze this relationship using contemporary methodology. Elucidating the intersection between intrapsychic and interpersonal experience is unprecedented in the literature and constitutes one of the central aims of the present study.

2.2.3. Experiences in Close Relationships (ECR)

In optimal development, the reciprocal relationship between differentiation and relatedness creates the conditions for both a secure attachment relationship and a sense of psychological autonomy, or identity. That is, relatively low levels of attachment anxiety and avoidance allow the individual to maintain a balance between healthy connectedness and independent autonomy, in the context of attachment security. As discussed in the previous sections, this is a difficult balance for patients with BPD to achieve. Therefore, it is important to assess the attachment style of these patients to better understand how attachment anxiety and avoidance relate to other aspects of interpersonal functioning in these patients (for a review, see K.N. Levy, Ellison, Scott, & Bernecker, 2011).

Based on a thorough review and analysis of several self-report attachment measures, Brennan and colleagues (1998) created the Experiences in Close Relationships (ECR) self-report to measure attachment anxiety and avoidance, as two distinct dimensions. The authors report that attachment anxiety is associated with sensitivity to

rejection whereas the combination of moderate to high attachment anxiety and low avoidance reflects what attachment researchers refer to as *preoccupied* attachment and high anxiety with high avoidance indicates *fearful* attachment. Although preoccupied is the most common attachment category among patients with BPD, there is substantial evidence of heterogeneous attachment classifications in this clinical population, which is why many individuals with BPD have attachment profiles that reflect both preoccupied and fearful attachment or cannot be classified due to the presence of multiple, conflicting attachment styles (Bartz et al., 2011; Choi-Kain, Fitzmaurice, Zanarini, Laverdière, & Gunderson, 2009; Kenneth N. Levy, Beeney, & Temes, 2011; K. N. Levy, Meehan, Weber, Reynoso, & Clarkin, 2005).

It has been demonstrated that the dimensional scales of the ECR are appropriate for evaluating attachment style in samples of patients with BPD (Bartz et al., 2011; K. N. Levy et al., 2005; Scott, Levy, & Pincus, 2009). Those studies showed BPD patients scored higher in both dimensions and that individuals with BPD tend to exhibit either high anxiety and avoidance or high anxiety and low avoidance (e.g., Bartz et al., 2011). In accordance with previous findings, it is expected in the present study that participants in the borderline group will have higher scores on both the anxiety and avoidance dimensions, as measured by the ECR.

One question this study aims to answer is: how do anxiety and avoidance scores relate to affective response to social exclusion? Previous research has shown that participants with elevated attachment anxiety and avoidance experience more anger and rejection in response to social exclusion (Brennan et al., 1998; Critchfield, Levy, Clarkin, & Kernberg, 2008). Likewise, similar levels of attachment anxiety and avoidance in the

control group are likely to result in higher rejection and anger ratings following experiences of social exclusion. One study even demonstrated that the relationship between attachment anxiety and borderline features is mediated by negative affect and impulsivity traits (Scott et al., 2009).

If the findings reflect that insecure attachment styles correspond with higher ratings of rejection and anger to instances of social exclusion in Cyberball, this will be the first known study to experimentally corroborate the claims made by attachment researchers, in a borderline sample. Furthermore, attachment styles may relate to experiences of social exclusion and corresponding brain functioning distinct from the influence of developmental quality of object representations of self and other.

2.3. From Object Relations and Attachment to Interpersonal Behavior

Object relations theory has yielded a sound foundation for clinical comprehension of borderline personality disorder, yet it remains disconnected from behavioral features that are more readily quantifiable. Clarkin and his colleagues (2007) have articulated this dilemma:

The object relations formulations of borderline pathology are founded on extensive evaluation and treatment of these patients in clinical settings. This method of investigation has the advantage of being close to the actual experience of these patients. It has the disadvantage of lacking objective, quantifiable measures of pathology, and thus must be supplemented and modified by experimental data (p. 476).

This suggests that the developmental quality of object representations (and similarly, attachment style) can and should be reinforced by objective experimental measures of these patients' experience of present encounters with others. On one level, this represents an effort to reconcile psychic features of the disorder with the patient's experience of

interpersonal situations. Thus, there is a demand to collect data that reflects the different dimensions of BPD. The present study achieves this by employing a multi-level design, one that bridges object relations and mechanisms of social cognition.

2.3.1. Social Cognition and BPD

Social cognition is a term that represents an impressive range of human functioning in social contexts. It encompasses the cognitions, beliefs, perceptions, and affects involved in information processing and behavioral responses of an individual when presented with an interpersonal situation. These interpersonal scenarios are inherently ambiguous and thus subject to great variability in terms of individual perception and response. Such scenarios can be broken down into elements of social perception (e.g., emotion recognition). This allows the component mechanisms of social cognition to be studied in relative isolation, in order to determine how they are impaired in clinical samples, and to what degree. A host of experimental paradigms have been developed in order to test these different facets of social cognition.

A growing body of research suggests that the social cognitive functions of individuals diagnosed with BPD are distinct from non-clinical controls and other clinical populations. Specifically, the studies that will be discussed (below) have reported hypersensitivity to social stimuli, conflicting results pertaining to accuracy of emotion recognition, biases of mistrust and negativity, and impairment in complex social integration. Many of the specific findings have not been replicated and there is wide debate regarding interpretation of results. Therefore further investigation into these

components of social cognition is necessary. In this section the literature is reviewed and limitations that the present study aims to address will be highlighted.

Noting the central importance of interpersonal functioning, researchers have begun to investigate several facets of social perception of patients with BPD. Early studies using projective measures (e.g., Thematic Apperception Test) showed that patients with BPD are incisively perceptive, readily attributing intentions to the actions of others (Nigg, Lohr, Westen, Gold, & Silk, 1992; Segal, Westen, Lohr, R. Silk, & Cohen, 1992; Segal, Westen, Lohr, & Silk, 1993; Westen, 1990, 1991a, 1991b; Westen, Lohr, Silk, Gold, & Kerber, 1990). More recently, researchers have developed tasks that are more consistent with real world interpersonal experiences. For example, these use pictures of faces, videos of social interaction, or measures that require participants to ‘mentalize’ (i.e., imagine how they would respond to a given situation).

Findings from studies of facial emotion recognition in patients with BPD have been inconsistent. Compared to non-clinical controls, some studies have reported that individuals with BPD are more accurate (E. A. Fertuck et al., 2009; Frick et al., 2012; Lynch et al., 2006; Schulze, Domes, Köppen, & Herpertz, 2012) whereas others have failed to detect a significant difference (Domes et al., 2008; M. J. Minzenberg, Poole, & Vinogradov, 2006; Preißler, Dziobek, Ritter, Heekeren, & Roepke, 2010). It remains unclear to what extent the discordance can be attributed to methodological variance and therefore to what extent differences in facial perception contribute to the social disturbances suffered by these patients.

There has been some consistency among studies of emotion recognition insofar as patients with BPD exhibit biases toward perceiving anger and untrustworthiness in faces

(Domes, Schulze, & Herpertz, 2009; M. J. Minzenberg et al., 2006). Similarly, it has been shown that both the estimation of the others' intentions and their general impressions of others are more malevolent than those of non-clinical controls (Arntz & Veen, 2001). Furthermore, some argue that patients with BPD are impaired in their ability to recognize emotion, thoughts, and intentions—more complex forms of social cognition (Preißler et al., 2010). These results converge with self-report findings that individuals with BPD report less trust and social support in their relationships than non-clinical controls (Clifton, Pilkonis, & McCarty, 2007). The implication is that patients with BPD are particularly sensitive to social situations and are more likely than controls to attribute malevolence to others. Gunderson and Lyons-Ruth (2008) have conceptualized this as an interpersonal hypersensitivity phenotype that predisposes these patients to social dysfunction.

Attaining trust is the most crucial factor in the establishment and maintenance of the therapeutic alliance with borderline patients (Langley & Klopper, 2005). Accordingly, recent studies have measured trust appraisal in individuals with BPD. In these studies patients engage in variations of a task that requires economic exchange with another player. They have all found that participants with BPD are less trusting of others, compared to non-clinical controls (Franzen et al., 2011; King-Casas et al., 2008; Unoka, Seres, Aspán, Bódi, & Kéri, 2009). One of the studies concluded that the lack of trust is likely related to “stress-related paranoia, dissociation, identity disturbance, and problems in interpersonal relationships” (Unoka et al., 2009, p. 399).

2.3.2. *Minding the Gap*

To date, it has been demonstrated that patients with BPD exhibit hypersensitivity to social cues, biases of mistrust and anger, and attribute negative intentions to the actions and intentions of others. All of these are consistent with the turbulent relationship patterns often reported by these patients in clinical and research settings. Most of these findings have relied on perception of static social stimuli or responses from patients as outside observers of social stimuli involving third parties (e.g., movies). However, relatively few studies have examined the response of patients when they are actually engaged in unfavorable interpersonal situations. Those that did employed paradigms that required patients to interact with others, but have aimed at more complex economic transactions and strategies of cooperation and competition. This represents a crucial gap in the literature in which the characteristic response of patients with BPD to interpersonal experiences is largely unexamined.

It is evident from the clinical presentation of these patients that they are prone to experiencing their social partners as rejecting. Yet almost none of the social cognition experiments have examined patient responses to social interactions that are likely to provoke rejection, frustration, or social exclusion. The present study therefore asks the following three questions: (1) How do borderline patients react to scenarios that may elicit rejection, discomfort, or anger?; (2) How do reactions to such experiences in the present relate to preexisting internal object representations?; *and* (3) Are there any differences in neural activation patterns associated with these forms of social experience? In other words, if we consider that object relations represent a historically relevant interpersonal model of functioning, how does this internal experience load onto

interpersonal interactions in the present and what bearing do those interactions have on neuronal activity?

Interestingly, this has not been adequately addressed by either clinical theories or experimental studies. Understanding the relationship between these different aspects, or levels, of the pathology will help to clarify the interaction between intrapsychic factors, real world experience of interactions with others and associated neurobiological functioning. Indeed this is only possible by using an experimental design. Therefore, this is a model that not only offers a bridge between the most relevant clinical and research perspectives on borderline personality disorder, but also has the potential to impact the lives of patients by advancing our understanding of the disorder (see Table 1; Erbe, Diamond, & Fertuck, 2012).

Table 1. *A Multi-Level Approach*

Level	Measure	Unit(s) of Measurement
1. Mental Representation	Narrative ORI ECR (Attachment style)	Differentiation-Relatedness Anxiety/avoidance scores
2. Social Cognition	Cyberball Task	Rejection & anger ratings
3. Neural	fMRI	Neural activation patterns

This table outlines the layers of investigation in the experimental paradigm used in this study. Developmental quality of differentiation-relatedness (D-R) is measured from participant narratives and attachment style is assessed from the ECR self-report. Then these data are analyzed in relation to rejection and anger ratings from the Cyberball data. Patterns of neural activity associated with social exclusion are also analyzed. Correspondence among these three layers of data is then evaluated.

2.4. Social Exclusion: A Social Cognitive Neuroscience Approach to BPD

Social acceptance and belonging is a fundamental component of human development. It is crucial for motivation and “affects the development, well-being, and behavior of the individual” (Staebler, Helbing, Rosenbach, & Renneberg, 2011, p. 275). When a person does not feel accepted or even rejected outright, there are emotional and cognitive consequences that may affect the individual’s behavior. Patients diagnosed with BPD are acutely sensitive to this. They present with relationship problems that often include patterns of rejection or perceived rejection by their family, friends, and romantic partners. In fact, there is also neurobiological evidence that exclusion by one’s peers increases activation in both the dorsal anterior cingulate cortex (dACC) and anterior insula, regions of the brain associated with physical pain (Eisenberger, Lieberman, & Williams, 2003).

This was the pioneering study that introduced the Cyberball task into the field of neuroscience. Cyberball is an experiment that engages participants in several rounds of a virtual game of catch with two other partners. Rate of inclusion (i.e., number of ball tosses received) is varied; in some rounds the participant receives a small percentage of throws and therefore watches the other two partners toss the ball between each other, hence the participant becomes socially excluded. The original finding that correlated social exclusion with increased activation in the dACC and anterior insula has been replicated several times over (Bolling et al., 2011; DeWall et al., 2010; Gunther Moor et al., 2012; Masten et al., 2009; Masten, Telzer, Fuligni, Lieberman, & Eisenberger, 2012). It is one of few experimental paradigms of social cognition that enlists participants in the task and therefore measures their reaction to actually being excluded in a social situation.

The ecological integrity of the approach is valuable and unique and therefore one of the reasons it was selected for the present study.

2.4.1. Social Exclusion and Rejection Sensitivity

The authors of the only study of social exclusion in patients with BPD used an adaptation of the Cyberball paradigm and found no difference in rejection ratings between the borderline and control groups (Ruocco et al., 2010). In the original Cyberball paradigm participants responded to several questions after each round, but from the report by the authors of this more recent study it is unclear which responses to the task were analyzed or how. This makes interpretation of their results difficult. Further research in this area is needed to clarify the specific reactions of borderline patients to situations of social exclusion.

Lack of prior findings in the specific area of social exclusion warrants review of an analogous construct, *rejection sensitivity*. The subjective experience of rejection is thought to vary between individuals and operationalization of the experience has thus been labeled rejection sensitivity. Downey and colleagues (2004) have defined it as: “the disposition to anxiously expect, readily perceive and intensely react to rejection” (p. 668). According to the concept, a continuum of sensitivity is assumed. At lower ends of this spectrum individuals sustain discrete experiences of rejection better than those who are more sensitive. The anxious anticipation of rejection is a maladaptive response, based on the finding that those who are highly rejection sensitive tend to elicit more rejection from others. Here the relevance to the borderline diagnostic population is quite evident.

The association between rejection sensitivity and social exclusion is appropriate because rejection sensitivity targets the subject of social rejection, similar to paradigms that measure more immediate experience of social exclusion. They are complementary insofar as an individual's sensitivity to being rejected is elicited by instances of social exclusion. In their operational forms, the key distinction is that rejection sensitivity is typically assessed through self-report questionnaires as a *trait* measure (i.e., level of rejection expectation), whereas social exclusion can only be invoked by a live experimental manipulation and thus measures *state* (i.e., experience of being rejected). Therefore findings from studies of rejection sensitivity will offer an important context for understanding the possible reactions of borderline patients to social rejection.

2.4.2. *Rejection Sensitivity and BPD*

Expectation of rejection in interactions with others is a prevalent feature in patients with borderline personality disorder (Ayduk et al., 2008). For example, they often magnify disagreements or social slights and interpret them as attacks. These experiences can be construed as rejection with the effect of eliciting aversive tension (Stiglmayr et al., 2005). In turn, patients are prone to resorting to maladaptive behaviors, such as impulsivity, self-harm, and destructive behavior toward others (Dutton, 1994, 1995; Twenge, Catanese, & Baumeister, 2002). When patients with BPD feel rejected they can become emotionally numb, lack meaningful thoughts, avoid self-awareness, and experience lethargy (Twenge, Catanese, & Baumeister, 2003).

Studies that have examined the relationship between rejection sensitivity and borderline pathology have consistently reported a positive correlation (Ayduk et al.,

2008; Meyer, Ajchenbrenner, & Bowles, 2005; Miano, Fertuck, Arntz, & Stanley, 2013; Staebler, Helbing, et al., 2011). These findings were significant in comparison with other clinical samples and non-clinical controls. One of the studies showed that borderline personality features were significantly associated with rejection-related expectancies and anxieties (Meyer et al., 2005). Another highlighted common reactions of aggression or withdrawal in those with BPD (Staebler, Helbing, et al., 2011). Evidence for the negative impact on relationships and interpersonal functioning in this group has been empirically demonstrated (Ayduk, Downey, & Kim, 2001; G. Downey, Freitas, Michaelis, & Khouri, 1998). For example, researchers have found that borderline features are associated with both rejection sensitivity and lower ratings of trustworthiness, which was measured using a face appraisal task (Miano et al., 2013). Another study that compared individuals diagnosed with BPD to non-clinical controls showed that this mistrust bias is specific to these patients and is not attributed to deficits in either ability to discriminate trustworthiness or sensitivity to trust (Eric A. Fertuck, Grinband, & Stanley, 2013). Furthermore, the bias was not found when the two groups rated faces for fear, which suggests the untrustworthy bias is specific and unique.

One of the studies presented findings regarding the relationship between rejection sensitivity and executive control (Ayduk et al., 2008). Using a General Linear Model analysis, these authors discovered that the interaction between high levels of rejection sensitivity and low executive control was predictive of BPD features. In other words, for individuals who self-reported low executive control there was a high correlation between rejection sensitivity and borderline features. Therefore, executive control may be a protective factor in highly rejection sensitive individuals against BPD features. This

foreshadows findings from the neuroscience literature that demonstrate dysfunctional neural networks that lead to heightened sensitivity (see section 2.4.3.).

Severe and/or prolonged rejection by significant others is likely to predispose one to this kind of sensitivity in interpersonal situations. This is true of rejection at any time in life, but even more so during childhood (Feldman & Downey, 1994). Sensitivity to rejection in patients with BPD appears to arise from relationship histories that are characterized by mistrust and feelings of rejection, exclusion, and/or abandonment (Veen & Arntz, 2000). It has been proposed that the etiology of this disorder is related to abusive and rejecting families (Rogosch & Cicchetti, 2005; White, Gunderson, Zanarini, & Hudson, 2003; Zanarini, 2000) and insecure attachment (Fonagy, Target, Gergely, Allen, & Bateman, 2003; K.N. Levy, 2005). Therefore, some have argued that experience of rejection is a key area of interest for understanding the social cognition of these patients (Ayduk et al., 2008; Ruocco et al., 2010).

Only one report has shown evidence for the impact of object representations on rejection sensitivity in BPD (Ghiassi, Dimaggio, & Brüne, 2010). The authors used an event-sequencing task that required participants to arrange separate sets of cards that depicted stages of interpersonal scenarios in a logical sequential order. They then completed one questionnaire that required mentalizing functions to assess beliefs, false beliefs, intentions, deception, and reciprocity of the characters and another to assess memory of parental qualities.

There was no difference between borderline patients and controls on the mentalizing questionnaire, but correlated with lower mentalizing scores on the questionnaire in the BPD group. Furthermore, history of separation from the parent

before seven years of age predicted the largest proportion of variance on the questionnaire. The authors speculate that such experience obstructs development of and prevents interaction—and possibly quality of internalization?—with caregivers. These findings represent the only empirical attempt to reconcile the relationship between social cognition and experience of rejection with actual caregivers.

A limitation to the rejection sensitivity findings is that each study qualified their sample differently with only one of the four including a DSM-diagnosed sample of BPD patients among their experimental groups (Staebler, Helbing, et al., 2011). Furthermore, measures of rejection sensitivity are inconsistent among the studies and only two did not use the Rejection Sensitivity Questionnaire (Ghiassi et al., 2010; Meyer et al., 2005). Therefore these results represent a conceptual framework that requires further testing. The present study is one of the first to examine the impact of experienced social exclusion in patients with BPD and the first to do so using fMRI.

2.4.3. The Social Cognitive Neuroscience of BPD

Social Cognitive Neuroscience (SCN; Adolphs, 2003b; M.D. Lieberman, 2007; Ochsner & Lieberman, 2001) is an empirical approach that addresses the interactional relations between social behavior, social cognitive processes, and the brain mechanisms underpinning social cognition. Typically, SCN studies utilize social cognitive laboratory approaches in a neuroimaging environment to bridge the social mind with the functioning of the brain. Therefore, this approach is well suited for addressing the problem of interpersonal dysfunction in BPD.

A number of studies have reported altered brain structure and volume (e.g., measuring gray matter density) in patients with BPD. Abnormal brain maturation in adolescent girls with features of borderline personality (Houston, Ceballos, Hesselbrock, & Bauer, 2005; Takahashi et al., 2010) and other structural findings in brains of individuals with BPD have been reported (Irlle, Lange, Weniger, & Sachsse, 2007; M.J. Minzenberg, Fan, New, Tang, & Siever, 2008; Rüschi et al., 2003; Tebartz van Elst et al., 2003). These findings are preliminary and may indicate structural brain changes associated with BPD, though at this point it is unknown whether they are the cause or consequence of BPD and the environmental risk factors associated with its development.

The neurobiology of social appraisal in BPD has been investigated using various paradigms from social psychology and cognitive neuroscience. When patients are exposed to emotional and neutral faces and negative emotional stimuli they exhibit greater amygdala activation than controls (Donegan et al., 2003; Herpertz et al., 2001; Koenigsberg et al., 2009). In particular, fear has been shown to produce increased activation of the right amygdala and less activation in the bilateral rostral/subgenual anterior cingulate cortex (ACC) in BPD relative to controls (M. J. Minzenberg, Fan, New, Tang, & Siever, 2007). One report has suggested that the amygdala might be a modulator of perceptual cortex, thereby increasing attention to emotional stimuli in patients with BPD (Herpertz et al., 2001). Individuals with BPD also exhibit problems *regulating* stress and emotion, as evidenced by a dysfunctional network including the ACC and frontal brain regions (Wingenfeld et al., 2009). Some have suggested that a broader dysfunction in the frontolimbic network mediates borderline pathology (M. J.

Minzenberg et al., 2007; M.J. Minzenberg et al., 2008; New et al., 2007; Schmahl & Bremner, 2006).

In the presence of social emotional stimuli, when individuals with BPD were instructed to employ distancing strategies to negative pictures, compared to looking at them, there was less activation change between conditions, compared with controls, in cognitive control regions (dorsal ACC, intraparietal sulcus, superior temporal sulcus, and superior frontal gyrus) and less deactivation in the amygdala (Koenigsberg et al., 2009). This suggests lack of functional connectivity between frontal regions (e.g., Orbito-Frontal Cortex) and the amygdala causes impaired cognitive control of emotion in BPD (Berlin, Rolls, & Iversen, 2005; New et al., 2007; Silbersweig et al., 2007). This appears consistent with the finding that correlated the low executive control and high rejection sensitivity profile with BPD diagnostic features (Ghiassi et al., 2010).

Few studies have been conducted on the neurobiological correlates of attachment patterns in patients with BPD. One study employed a paradigm in which patients with BPD were asked to construct a narrative in response to attachment-related stimuli. Individuals with BPD showed greater activation in anterior medial cingulate cortex (aMCC) in response to monadic pictures (single character) and more right superior temporal sulcus activation and less activation in right parahippocampal gyrus for dyadic pictures (two characters), relative to non-clinical controls (Buchheim et al., 2008). The authors argued that attachment trauma might underlie interpersonal symptoms of BPD.

Although a handful of studies have reported on the neural correlates of attachment classification (Lemche et al., 2005; Suslow et al., 2009; Vrtička, Andersson, Grandjean, Sander, & Vuilleumier, 2008), no one has looked at the neural correlates of interpersonal

processes in patients with BPD, relative to internal object representations (i.e., D-R) and attachment style. In the paradigm this is a crucial concern because, as Vrticka and colleagues (2008) have argued, over-and-above its effects on facial feature processing, attachment status contextualizes perception of social stimuli and it is believed that the same might be true for overall developmental quality of object relations (Erbe et al., 2012).

In contrast to studies of emotion processing of social stimuli, social cognitive neuroscience reports on interpersonal processes in BPD are limited. One fMRI study reported that individuals with BPD were impaired, relative to controls, in their ability to trust their partners in an economic exchange task and this lack of cooperation was related to dysregulated activation in the anterior insula in those with BPD (King-Casas et al., 2008).

As mentioned before, there has been one study that compared the neural activity of borderline and control samples while participants played Cyberball (Ruocco et al., 2010). Although they did not see any differences in behavioral ratings between the groups, the patients with BPD showed increased activation in medial prefrontal cortex during social exclusion. The authors surmise that this is evidence of frontolimbic pathway dysfunction, but the limitations of their functional near infrared spectroscopy (fNIRS) prevented imaging of deeper limbic structures (e.g., amygdala). Nevertheless, this offers an important preliminary finding that medial prefrontal hyperactivation may be one of the neural signatures of social exclusion in borderline patients.

The present study investigates the ways in which interpersonal hypersensitivity, evident in BPD, is subserved by developmental quality of differentiation-relatedness,

attachment style, and social exclusion. Moreover, it aims to assess whether response to social rejection, as measured in Cyberball, is related to a lower developmental quality of differentiation-relatedness of mental representations of self and others and attachment style in this patient population. Thus the link between mental representations, experience of exclusion in social interaction and associated patterns of neural activity is examined.

2.5. A Multi-Level Approach

It is apparent from reviewing the literature that previous theory and experimental work has done little to address the multiple levels inherent to borderline personality disorder. Yet each level has been studied independently or in pairs (e.g., social cognition and neural activation). Westen (1991b) argues that object relations and social cognition share a common interest in cognitive and affective processes that “mediate interpersonal functioning” (p. 429). Others have developed terminology to account for various aspects of the disorder. For example, Blatt and Auerbach (2003) have observed that intersubjectivity is the prerequisite context for both object relational and attachment perspectives of mental life. They argue that the term *mental representation* is well suited to encompass certain aspects of social cognition, representations of self and significant others and styles of attachment (S.J. Blatt & Auerbach, 2003). Mental representations (i.e., object representations and internal working models of attachment) are shaped by primary early relationships. They constitute cognitive and affective schemas that are then active in novel interpersonal situations in the present (e.g., observed in social exclusion). It has been argued that the cognitive and affective schemas function as heuristic prototypes that are the basis for social interaction and behavior (Fiske & Taylor, 1984;

Horowitz, 1988; Markus, 1977; Westen, 1991b). This conception of mental representation preserves an opening that is capable of accommodating a broad range of social cognitive functions (such as those discussed in 2.3.1. *Social Cognition and BPD*). Indeed, both the conceptualization of mental representation and the term itself are useful, but it does not address the neurobiology or methodology required to bring these lines of investigation together.

Some have begun to conceptualize the problem of borderline personality disorder on all three of the levels described (e.g., Fonagy & Luyten, 2009). This is an important first step toward investigating the disorder, in all its complexity. However, it also represents both the lack of and demand for experimental paradigms that are capable of testing these types of complex theories.

The present study aims to achieve this next step. It is important to keep in mind that the psychoanalytic object relations and attachment approaches are crucial here because internalized object representations and attachment style shape how a person approaches life. Understanding the quality of object relations and attachment anxiety and avoidance will provide a context for understanding sensitivity to social exclusion and the associated neural problems. It is likely that the malevolent internal representations and insecure attachment of borderline patients have a direct impact on their experience of interpersonal interactions in the here and now.

Novel experimental paradigms and neuroimaging tools offer opportunities to investigate relevant mechanisms. The present study takes advantage of these developments by employing several experimental measures that address different aspects of the experience of patients diagnosed with BPD. It should be noted that the measures

used in the present study represent a range of methods; narrative coding, self-report, and neuroimaging are very different tools. Nevertheless, they are among the most accessible and effective in measuring the phenomena of interest, considering the broad range of characteristics this study addresses. Given the relevant advances in available methodology, technology, and experimental paradigms, there are many questions that remain unanswered and it is the aim of the present study to draw these disparate lines of investigation together to better understand the unique constellation of mental representations, social exclusion, and the neural underpinnings, all of which contribute to the pathology known as borderline personality disorder.

2.6. Research Questions and Hypotheses

From the literature review it is clear that developmental quality of differentiation-relatedness of object representations and attachment style is closely associated with perception of and response to social exclusion. Therefore, both of these are also likely correlated with patterns of neural activation in individuals with BPD distinct from activations found in non-clinical controls. Examining correspondences between the D-R from the ORI, attachment style, and social exclusion will help to distinguish between distinct features of these mental phenomena. Furthermore, understanding the relationship between mental representations and response to social exclusion in individuals with BPD might delineate the ways in which internalized object representations predict “real world” social interactions. Thus there are several key questions that will be explored:

Q1: Do individuals with BPD have lower developmental quality of differentiation-relatedness of internal object representations than non-clinical controls?

H1: Borderline patients will exhibit lower developmental quality (i.e., lower differentiation-relatedness scores) of self and object representations on the ORI than controls.

Q2: Do individuals with BPD have higher attachment anxiety and avoidance than non-clinical controls?

H2: Borderline patients will exhibit greater scores than controls for attachment anxiety and avoidance on the ECR.

Q3: Are individuals with BPD more sensitive to social exclusion than non-clinical controls?

H3: Patients with BPD will report greater negative affect, as measured by subjective ratings of rejection and anger, than controls during the Cyberball task.

Q4: Does developmental quality of differentiation-relatedness with respect to object representations predict negative affective response to social exclusion?

H4: Differentiation-Relatedness scores will negatively predict ratings of negative affect (rejection and anger) during Cyberball.

Q5: Does attachment style predict negative affective response to social exclusion?

H5: Attachment style, measured by the ECR, will positively predict rejection and anger rating response during Cyberball.

Q6: Are there neural activation patterns that correspond specifically to negative affective responses (i.e., rejection and anger) to social exclusion events and are these patterns modulated by either D-R or attachment style?

H6: Participants who produce high rejection and anger ratings will exhibit greater dorsal anterior cingulate cortex (dACC) and anterior insula activation (Eisenberger et al., 2003), hyperactivation of the medial prefrontal cortex (PFC; Ruocco et al., 2010), and less activation in lateral PFC (Kross, Egner, Ochsner, Hirsch, & Downey, 2007) in response to social exclusion relative to those who give low ratings for feelings of rejection and anger.

CHAPTER III

Method

3.1. Participants

Participants in this study were 29 females between the ages of 19 and 35. They were recruited through advertisements, fliers, and word of mouth. Of those who participated, 14 met DSM-IV criteria for BPD and 15 were enrolled as non-clinical controls. Trained interviewers and licensed clinical staff assessed these participants using the Structured Clinical Interview for DSM-IV, Patient Edition (SCID-I; Spitzer, Williams, Gibbon, & First, 1990) and Structured Clinical Interview for DSM-IV Axis II Personality Disorders (SCID-II; Gibbon, Spitzer, & First, 1997). Exclusion criteria for the BPD group were bipolar I disorder, schizophrenia and other psychotic disorders, current post-traumatic stress disorder (PTSD), mental retardation, history of severe head trauma, or other cognitive impairments that might interfere with the accuracy of assessments or competency to give informed consent. None of these participants were on psychiatric medication during the study and those who reported recent suicide attempts (within past six months) or suicidal ideation with a plan and intent (within past three months) were excluded from participation. All BPD participants were free of neurological disease as determined by clinical history and examination.

Participants in the non-clinical control group were screened using the same structural interview to ensure the absence of current and past Axis I and Axis II psychiatric disorders. These participants were also free of medication. This group was matched with the BPD group on demographic variables of race/ethnicity, age, and education level.

Given the safety parameters of participating in the MRI, none of the participants were pregnant or had a heart pacemaker or other metal in their body at the time they were scanned. The Institutional Review Board of the New York State Psychiatric Institute approved the study. All participants were informed about the risks and benefits of participation and provided informed consent prior to participation. Full demographic and clinical characteristics of the sample are reported below (see Results section; Tables 2, 3, and 4).

3.2. Measures

3.2.1. Clinical Assessment

The Structured Clinical Interview for DSM-IV, Patient Edition (SCID-I; Spitzer et al., 1990) and Structured Clinical Interview for DSM-IV Axis II Personality Disorders (SCID-II; Gibbon et al., 1997) were used to determine diagnoses for individuals with Borderline Personality Disorder. The Global Assessment of Functioning (GAF) is a single scale score (0-100) that is used by licensed clinicians to determine an overall rating of social, occupational, and psychological functioning. The Columbia Suicide History interview was given to assess number of prior suicide attempts (Posner et al., 2011).

Attachment

Attachment style was assessed using the Experiences in Close Relationships instrument (ECR), a 36-item self-report questionnaire divided equally into two attachment dimensions: anxious-preoccupied and avoidance (see Appendix B; Brennan et al., 1998). This measure was derived from the authors' principal components analysis of hundreds of items from 60 self-report measures of attachment. Attachment anxiety and

attachment avoidance were the two primary factors that resulted from their analysis. Reliability, internal consistency, and validity of the scales have all been demonstrated (Brennan et al., 1998; Mikulincer & Shaver, 2010). Each item is rated on a 7-point scale to indicate how the respondent feels about certain aspects of being in romantic relationships. Anxious-preoccupation corresponds to anxiety and vigilance concerning rejection and abandonment (e.g., I worry about being abandoned). Avoidance corresponds to discomfort with closeness and dependency or a reluctance to be intimate with others (e.g., I am nervous when partners get too close to me). Therefore the measure indicates to what degree the participant can be classified as either attachment anxious or attachment avoidant.

Depression

Severity of depression symptoms was assessed using the Hamilton Depression Inventory (Ham-D; Hamilton, 1960).

Object Relations

The Object Relations Inventory (ORI; S.J. Blatt et al., 1979) is an open-ended interview that elicits responses to four prompts: “Describe your...mother, father, self, a significant other”. Participants were asked to say anything that came to mind for five minutes about self and significant others without interruption—a procedure derived from the five minute speech sample developed by Gottschalk (1968). If the individual stops before the five minutes she is prompted to continue as follows: “Please tell me anything else about yourself (or significant others) in the time remaining (that is, however many minutes are left).” If after one prime the participant is unable to continue, the prime may be repeated one more time. The advantages of this procedure are (a) that it standardizes

the amount of time that the individual has to provide the description and (b) that it may encourage the free associative process because the person is asked to speak for five minutes without interruption. Interviews were videotaped for the purposes of transcription and scoring.

The ORIs were scored using the Differentiation-Relatedness (D-R) scale, which is a 10-point ordinal scale (see Appendix A) that assesses the developmental quality of descriptions of self and significant others (D. Diamond, Blatt, S.J., Stayner, D.A., Kaslow, N., 1993b). A number of studies have demonstrated the reliability and validity of these scales (S.J. Blatt et al., 1996).

Scoring the five-minute speech sample version of the ORI requires the rater to assign three separate scores to each response: (1) overall D-R score; that is, the score that best represents the most prevalent and consistent strategy of Differentiation-Relatedness; (2) the lowest D-R score in the interview; and (3) the highest D-R score (D. Diamond, Blatt, S.J., Stayner, D.A., Kaslow, N., 1993b). The rationale for this scoring method is that the ORI given as a five-minute speech sample often generates much more material than does the ORI given as a semi-structured interview, and therefore yields a broader range of possible D-R ratings.

The author, a clinical psychology doctoral candidate, conducted all ORIs. Interview transcripts were scored by Dr. Benedicte Lowyck, a clinical psychologist who was blind to all participant information and to the nature and purpose of the study. Interrater reliability was established between the author and BL (both of whom were trained beforehand by the authors of the ORI manual) with an Intraclass Correlation Coefficient (ICC; random set) of 0.89, which is consistent with, and in some cases better than ICC

established by previous studies (D. Diamond, Blatt, S.J., Stayner, D.A., Kaslow, N., 1993a; Vermote, 2005; Vermote & Lowyck, 2009). Scoring discrepancies between BL and the present author were resolved through consensus ratings achieved through consultation with Dr. Diana Diamond, the primary author of the D-R manual.

Rejection Sensitivity

This was measured using the Rejection Sensitivity Questionnaire (RSQ; Geraldine Downey & Feldman, 1996). The RSQ is a 9-item questionnaire that requires participants to consider hypothetical interpersonal scenarios and provide ratings based on how they would react as well as their expectation of the other person involved in the questions.

State Affect

The Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1981) is a 65-item self-report questionnaire designed to assess concurrent negative emotional state. It yields a total score for negative emotion states based on the following six transient states: tension-anxiety, depression-dejection, anger-hostility, confusion-bewilderment, vigor-activity, and fatigue.

Traits

The Buss-Durkee Hostility Inventory (BDHI; Buss & Durkee, 1957) was used to measure hostility and aggression. During the demographic interview, physical and sexual abuse history before the age of 18 was assessed.

3.2.2. Psychophysical Assessment

Cyberball Task

The Cyberball task was utilized to measure neural activity related to social inclusion and exclusion. Cyberball (Eisenberger et al., 2003) is virtual ball-tossing game in which participants believe they are playing catch with two other players through a computer network (they are not actually playing other people, but the deception is necessary for the task and participants are debriefed afterwards). The subject presses one of two buttons to indicate which player she chose to throw the ball to. The computer-generated players throw the ball to the participant with a probability that was under experimental control. During the first run, the virtual players throw the ball to the subject with a probability of 50%. For the remaining four runs, the probability was randomly counterbalanced among the following probabilities: 10%, 20%, 40%, and 60%. Each run is three and a half minutes.

This version of Cyberball was adapted from the one used by Eisenberger and colleagues. It was programmed using Matlab 6.1 (www.mathworks.com) and Psychtoolbox (www.psychtoolbox.org) on a Macintosh Powerbook (OS X). The Matlab program affords more precise manipulation of exclusion rates, run times, and as well as sensitive measurement of reaction times, throw order, and event timing.

3.3. Procedure

Phone screens were conducted to determine whether interested volunteers met major criteria for the study. Those who qualified were invited to the lab to be consented and undergo a more thorough baseline assessment, which included the diagnostic

interview (SCID I and II) and several self reports designed to assess recent mood, aggression, social and emotional functioning, relationships, rejection sensitivity, abuse history, impulse control, and attachment (e.g., ECR). A semi-structured interview to assess suicidality was administered with participants diagnosed with BPD. During the same visit, participants also completed urine toxicology and pregnancy tests. All participants were free of psychotropic medication.

Prior to participating in the MRI, participants were offered an opportunity to tour the scanning facility at the Neurological Institute of Columbia University Medical Center. On the day of their scan, participants completed mood questionnaires, a metal screening form, and another pregnancy test. They were also shown an article about a study that looked at related social phenomena using the Cyberball task [S. Nadis, *Nature*, 415, 364 (2002)]. Showing participants this article was consistent with the original study by Eisenberger and colleagues (Eisenberger et al., 2003). Exposing participants to the article suggested the credibility of the task and was meant to influence participants' belief that they were actually engaging with others via a computer network. Two confederates were introduced to participants as part of the instrumental deception. Participants were told these confederates were the other two players in the Cyberball game. Prior to the scan the research assistant instructed participants on the face appraisal task and briefly showed them the stimuli in order to prepare them for the actual task.

Next, the scan technician helped the participant with the focus on the visual equipment used to present the stimuli, setting up the response pad, connecting a breathing monitor, and heart rate (HR) and skin conductance (SCR) non-ferromagnetic Ag electrodes. After setup, the technician and research assistant communicated with the

participant, throughout the scan, from an adjacent control room. Pupil dilation was recorded during the scan using a video based infrared remote eye tracking system (ISCAN RK469).

Tasks were pre-programmed with Matlab 6.1 software (www.mathworks.com) and presented via goggles receiving a signal from the computer in the control room. Participants played five rounds of Cyberball. In this task they believed they were playing the confederates, however, it was pre-programmed for them to receive different percentages of ball tosses in each round (60, 50, 40, 20, and 10 percent of total tosses). The order of runs was randomized. At the end of each run the participant responded to several questions about their experience, using a five-point likert scale. These questions assessed participant self-esteem (“I felt liked”), belongingness (“I felt rejected”), meaningfulness (“I felt invisible”), control (“I felt powerful”), and other descriptors. Following the scan, the ORI was administered and videotaped in a separate room.

Upon completing the study, all participants filled out a brief questionnaire to determine whether they believed the deception in the Cyberball task (i.e., that they were actually playing with the confederates via the computer network). The deception was then explained and participants were debriefed about the nature, goals and purpose of the study. Finally, they were compensated for their participation at the end of their participation.

3.4. Data Acquisition and Analysis

Data analysis was performed using PASW/SPSS Version 21 on a Macintosh Computer. Matlab 6.1 (www.mathworks.com) was used to perform graphical analyses of psychophysical data. First, the variance within groups was assessed using a Shapiro-Wilk test of normality and resulting scatterplots were inspected and compared. Within-group variance was considered before proceeding with combining data from both groups, as some of the analyses required. Pearson correlations were then conducted to explore the relationship among the primary variables. Group differences were then analyzed using independent samples t-tests and the magnitude of the group differences was expressed by the effect size (ES).

The first hypothesis is that borderline patients will exhibit object representations of lower developmental quality (i.e., lower differentiation-relatedness scores) than controls. To test this hypothesis, independent samples t-tests were conducted to compare mean D-R scores between the non-clinical and BPD samples, for each category separately (e.g., mean score for ‘mother’ compared between groups; H1). An independent samples t-test was also used to find out whether the BPD group means for attachment anxiety, and attachment avoidance from the ECR were higher than non-clinical controls (H2). The same statistical analysis was also employed to determine whether the BPD group mean for rejection and anger response ratings during the Cyberball task was significantly greater than the non-clinical control group means (H3).

For the fourth hypothesis, bivariate regressions were conducted to determine whether any of the D-R variables predicted negative affective response to social exclusion, reflected in rejection and anger and decay variables (see Chapter IV Results).

Separate regressions were conducted using each of the four negative affect variables as the dependent variable. The same analysis was performed to determine whether attachment anxiety or avoidance significantly predicted negative affective response in Cyberball, for hypothesis 5.

Functional MRI was performed on a 1.5 Tesla GE using the EPI-BOLD sequence (TR = 2.0, TE = 36, flip angle = 34, slice thickness = 4mm, slice thickness = 5.5, number of slices = 27, number of volumes = 105, array size=64x64, FOV=200, duration of run = 3.5 minutes). Structural scans were performed using the 3D SPGR sequence (124 slices, 256 x 256, FOV = 200 mm).

Analysis of the neuroimaging data for hypothesis 6 was conducted using the FMRIB Software Library (FSL; Jenkinson, 2012 #6353) and Matlab 6.1 (www.mathworks.com). Preprocessing consisted of motion correction (McFlirt), slice timing correction, high-pass filtering (> 50s), and spatial filtering (FWHM = 5 mm). Standard statistical parametric mapping techniques (FEAT) were performed in original T2* space. Activation thresholds were set at $p = 0.05$, correction for multiple comparisons was done using Gaussian Random Field Theory with a cluster threshold of $p = 0.05$.

CHAPTER IV

Results

4.1. Demographic and Clinical Characteristics of Sample

Twenty-nine women ages 19 to 35 participated in this study. There were 14 participants in the group of women diagnosed with BPD and 15 in the non-clinical control group. An independent samples t-test was conducted to determine whether there were significant differences between clinical (N=14) and control groups (N=15) with regard to age, education, and intelligence (as measured by the WAIS vocabulary subtest scaled score; Table 1). The mean age of the BPD group was 27.29 (SD=4.62), which was significantly greater than that of the control group (M=23.67, SD=3.56; $t(27)=2.37$, $p=.03$), whereas no significant differences were found for education (BPD: M=15.36, SD=1.95; control: M=15.87, SD=1.89; $t(27)=-.72$, $p=.48$) or intelligence (BPD: M=14.36, SD=1.60; control: M=13.73, SD=2.34; $t(27)=.83$, $p=.41$). The significant difference between group age means did not significantly impact the results for the variables of interest. Chi-squared analyses showed no significant differences between groups in terms of ethnic identity and marital status (Table 2).

Table 2. Demographic Characteristics

	BPD (<i>n</i> =14)		Controls (<i>n</i> =15)		<i>t</i>	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Age	27.29	4.62	23.67	3.56	2.37	.025*
Education (years)	15.36	1.95	15.87	1.89	-.72	.480
WAIS Vocab Subtest Scaled Score	14.36	1.60	13.73	2.34	.83	.413
	<i>N</i>	%	<i>N</i>	%	χ^2	<i>p</i>
Race/Ethnicity					7.58	.056
Asian	1	7.14	4	26.67		
Black or African American	4	28.57	1	6.67		
White	6	42.86	10	66.67		
More than one race	3	21.43	0	0.0		
Hispanic/Latino	4	28.57	3	20.00		
White	6	42.86	10	66.67	1.66	.198
Non-White	8	57.14	5	33.33		
Married	3	21.43	0	0.0	3.59	.058
Not married	11	78.57	15	100.00		

***p* < .01, **p* < .05; all two-tailed tests

An independent samples t-test was used to determine whether there were significant differences in primary clinical characteristics between the two groups (Table 3). As expected, the BPD group showed significantly higher ratings on the Hamilton Depression Inventory (BPD: *M*=8.86, *SD*=5.67; control: *M*=.93, *SD*=1.75; *t*(27)=5.16, *p*=.00), Buss-Durke (BPD: *M*=31.86, *SD*=10.99; control: *M*=12.33, *SD*=7.43; *t*(27)=5.64, *p*=.00), POMS (BPD: *M*=34.07, *SD*=32.80; control: *M*=3.40, *SD*=13.32; *t*(27)=.27, *p*=.00), RSQ (BPD: *M*=15.63, *SD*=7.33; control: *M*=5.52, *SD*=2.84; *t*(27)=4.96, *p*=.00), and GAF (BPD: *M*=63.00, *SD*=8.80; control: *M*=87.60, *SD*=6.73; *t*(27)=-8.50, *p*=.00).

Table 3. Clinical Characteristics

	BPD (<i>n</i> =14)		Controls (<i>n</i> =15)		<i>t</i>	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Hamilton Depression Inventory	8.86	5.67	.93	1.75	5.16	.000**
Buss-Durke	31.86	10.99	12.33	7.43	5.64	.000**
POMS	34.07	32.80	3.40	13.32	.27	.002**
Rejection Sensitivity Questionnaire	15.63	7.33	5.52	2.84	4.96	.000**
GAF score	63.00	8.80	87.60	6.73	-8.50	.000**
	<i>N</i>	%				
Past suicide attempter	6	42.86				
Physical/sexual abuse (prior to 18)	5	35.71				
Sexual Abuse	3	21.43				
Physical abuse	4	28.57				
Lifetime non-suicidal self-injury	8	57.14				

***p* < .01, **p* < .05; all two-tailed tests

Analysis of co-occurring diagnoses measured by the SCID-I and SCID-II revealed evidence of co-occurring anxiety disorders in some participants with BPD (Table 4). The number of individuals with current or lifetime Axis I and Axis II diagnoses are also shown below. There were 11 participants (78.57%) with a history of Major Depression and four participants (28.57%) with a history of substance abuse. Four individuals (28.57%; one person met criteria for both paranoid and narcissistic personality disorders) met criteria for other Axis II personality disorders.

Table 4. *Co-Occurring Diagnoses of BPD Group (N=14)*

	<i>N</i>	<i>%</i>
Axis I Diagnoses: Current or lifetime		
Panic Disorder	4	28.57
Simple Phobia	1	7.14
Generalized Anxiety Disorder	3	21.43
Obsessive-Compulsive Disorder	0	0
Post Traumatic Stress Disorder	0	0
Social Phobia	3	21.43
Eating Disorder	0	0
History of Substance Abuse/Dependence	4	28.57
Current Substance Abuse/Dependence	0	0
History of Major Depression	11	78.57
Current Major Depression	0	0
Bipolar I	0	0
Bipolar II	0	0
Dysthymia	0	0
Axis II Diagnoses: Current		
Paranoid	1	7.14
Schizotypal	0	0
Obsessive-compulsive	1	7.14
Dependent	1	7.14
Antisocial	0	0
Narcissistic	1	7.14
Avoidant	1	7.14

4.2. Exploratory Data Analysis

Exploratory analyses of the data confirmed that all variables included in the analyses below were normally distributed. Therefore, parametric tests were employed to test hypotheses. Descriptive statistics and Pearson correlations are presented in Table 5.

Table 5. Correlation Matrix of Key Differentiation-Relatedness (D-R) Scores^a (N=28), Attachment Anxiety and Avoidance (N=29), and Rejection and Anger Scale and Decay Variables (N=29)

Variable	<i>r</i> (p)									<i>M</i>	<i>SD</i>
	D-R (ORI)			ECR		Cyberball					
	1	2	3	4	5	6	7	8	9		
1 DR –Mean	1.00	.706**	.863**	-.569**	-.416*	-.231	-.053	-.377*	-.148	6.02	0.56
2 DR–Father	—	1.00	.505**	-.490**	-.340**	-.228	-.095	-.527	-.166	5.89	0.88
3 DR–Self	—	—	1.00	-.547**	-.491**	-.246	-.169	-.397*	-.254	6.07	0.60
4 ECR-Anxiety	—	—	—	1.00	.702**	.324	.232	.378*	.215	3.17	1.59
5 ECR-Avoid	—	—	—	—	1.00	.083	.037	.227	.081	2.76	1.39
6 CB-Rej Scale	—	—	—	—	—	1.00	.675**	.621**	.609**	1.66	1.65
7 CB-Rej Decay	—	—	—	—	—	—	1.00	.587**	.848**	0.16	0.24
8 CB-Ang Scale	—	—	—	—	—	—	—	1.00	.757**	0.65	1.30
9 CB-AngDecay	—	—	—	—	—	—	—	—	1.00	0.06	0.12

***p* < .01, **p* < .05; all two-tailed tests

^a D-R overall score used

4.3. Testing the Hypotheses

4.3.1. Hypothesis 1 Analysis

The first hypothesis predicted that patients diagnosed with BPD would exhibit lower differentiation-relatedness (D-R) scores than non-clinical controls. An independent samples t-test was used in order to determine whether borderline patients exhibited significantly lower developmental quality (i.e., lower differentiation-relatedness scores) of object representations than controls (Table 6). Three global variables were derived from the ratings of differentiation-relatedness for self and object representations (i.e.,

‘mother’, ‘father’, ‘significant other’) by averaging scores for all four ORI narrative responses, by individual. The variables were labeled ‘mean overall’, ‘mean low’, and ‘mean high’. An independent samples T-test for the ‘mean high’ variable showed that the difference between differentiation-relatedness for the high scores was approaching significance (BPD: $M=6.22$, $SD=.59$; control: $M=6.63$, $SD=.50$; $t(26)=-2.02$, $p=.05$). However, there was a significant difference between BPD and control groups for ‘mean overall’ (BPD: $M=5.78$, $SD=.57$; control: $M=6.23$, $SD=.46$; $t(26)=-2.30$, $p=.03$) and ‘mean low’ (BPD: $M=5.18$, $SD=.42$; control: $M=5.86$, $SD=.65$; $t(26)=-3.24$, $p=.00$).

To further explore group differences corresponding to specific object relations, a t-test was conducted for overall D-R scores, followed by low and high scores. These analyses were carried out in a hierarchical fashion to reduce and structure the number of statistical comparisons of scores. Overall scores were analyzed first, followed by individual tests of objects when a significant difference at the overall level was found. There was no significant difference of overall scores for ‘mother’ (BPD: $M=5.77$, $SD=1.09$; control: $M=6.20$, $SD=.68$; $t(26)=-1.27$, $p=.21$) or ‘significant other’ (BPD: $M=6.05$, $SD=.73$; control: $M=6.20$, $SD=.56$; $t(26)=-.61$, $p=.55$) between groups. However, the BPD group showed significantly lower developmental quality of differentiation-relatedness than controls in overall ratings for ‘father’ (BPD: $M=5.54$, $SD=.88$; control: $M=6.20$, $SD=.78$; $t(26)=-2.12$, $p=.04$) and ‘self’ (BPD: $M=5.77$, $SD=.60$; control: $M=6.33$, $SD=.49$; $t(26)=-2.75$, $p=.01$).

The same pattern was discovered from the analysis of the low ratings. In other words, there was no significant difference in low ratings between groups for ‘mother’ (BPD: $M=5.00$, $SD=1.29$; control: $M=5.73$, $SD=1.10$; $t(26)=-1.62$, $p=.12$) or ‘significant

other' (BPD: $M=5.72$, $SD=.73$; control: $M=5.93$, $SD=.70$; $t(26)=-.79$, $p=.43$). However, the BPD group had significantly lower scores for developmental quality of differentiation-relatedness in response to 'father' (BPD: $M=5.08$, $SD=.76$; control: $M=5.69$, $SD=.77$; $t(26)=-2.11$, $p=.04$) and 'self' (BPD: $M=4.92$, $SD=.64$; control: $M=6.07$, $SD=.59$; $t(26)=-4.90$, $p=.00$).

There were no significant differences in high differentiation-relatedness scores between BPD and control groups for 'mother' (BPD: $M=6.23$, $SD=.83$; control: $M=6.73$, $SD=.80$; $t(26)=-1.63$, $p=.12$), 'father' (BPD: $M=6.15$, $SD=.80$; control: $M=6.60$, $SD=.51$; $t(26)=-1.79$, $p=.08$), 'self' (BPD: $M=6.15$, $SD=.80$; control: $M=6.53$, $SD=.64$; $t(26)=-1.39$, $p=.18$), or 'significant other' (BPD: $M=6.33$, $SD=.78$; control: $M=6.67$, $SD=.72$; $t(26)=-1.17$, $p=.25$).

Table 6. *Differentiation-Relatedness (D-R) Scores (ORI)^a*

	BPD (<i>n</i> =13)		Controls (<i>n</i> =15)		<i>t</i>	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Mean Overall	5.78	.57	6.23	.46	-2.30	.030*
Mean Low	5.18	.42	5.86	.65	-3.24	.003**
Mean High	6.22	.59	6.63	.50	-2.02	.054
Mother Overall	5.77	1.09	6.20	.68	-1.27	.214
Father Overall	5.54	.88	6.20	.78	-2.12	.044*
Self Overall	5.77	.60	6.33	.49	-2.75	.011*
Significant Other Overall	6.05	.73	6.20	.56	-.61	.547
Mother Low	5.00	1.29	5.73	1.10	-1.62	.116
Father Low	5.08	.76	5.69	.77	-2.11	.045*
Self Low	4.92	.64	6.07	.59	-4.90	.000**
Significant Other Low	5.72	.73	5.93	.70	-.79	.434
Mother High	6.23	.83	6.73	.80	-1.63	.115
Father High	6.15	.80	6.60	.51	-1.79	.086
Self High	6.15	.80	6.53	.64	-1.39	.175
Significant Other High	6.33	.78	6.67	.72	-1.17	.252

***p* < .01, **p* < .05; all two-tailed tests

^a Measured using 1-10 scale, where 1=low and 10=high

4.3.2. Hypothesis 2 Analysis

The second hypothesis predicted that borderline patients would exhibit higher scores of attachment anxiety and avoidance than non-clinical controls. An independent samples t-test was conducted to determine whether the BPD group scored higher for attachment insecurity (i.e., higher attachment anxiety and avoidance) compared to non-clinical controls (Table 7). There was a significant difference between BPD and control groups for both attachment anxiety (BPD: *M*=4.38, *SD*=1.19; control: *M*=2.05, *SD*=0.97;

$t(27)=5.81, p=0.00$) and attachment avoidance (BPD: $M=3.62, SD=1.42$; control: $M=1.96, SD=0.74$; $t(27)=4.00, p=0.00$).

Results from the correlation matrix (Table 5) above reflect a strong positive and highly statistically significant correlation between attachment anxiety and attachment avoidance ($r(29) = .70, p < .01$; Figure 1). Visual inspection of the data show that the correlation is driven by a substantial group difference for which correlational analysis reveals the positive correlation between anxiety and avoidance is only significant for patients and not controls. This is consistent with prior studies that found multiple attachment patterns associated with BPD, some of which report similar attachment style findings using the ECR (Diana Diamond & Blatt, 1994; K. N. Levy et al., 2005; Scott et al., 2009).

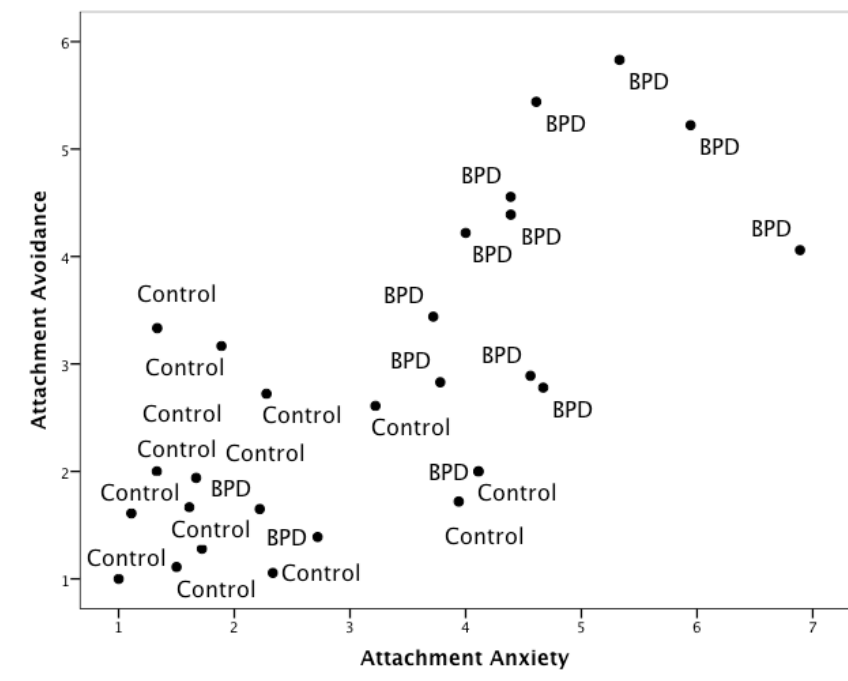


Figure 1. Scatterplot for Attachment Anxiety by Attachment Avoidance. Individual differences in attachment anxiety and attachment avoidance, as measured by the ECR, in

participants diagnosed with BPD and non-clinical controls. Consistent with prior research, BPD patients were either (1) high anxious and low avoidant ('preoccupied') or (2) high anxious and high avoidant ('fearful'), indicating heterogeneous attachment in BPD participants.

Table 7. Attachment Style (ECR)

	BPD (<i>n</i> = 14)		Controls (<i>n</i> = 15)		<i>t</i>	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Attachment Anxiety	4.38	1.19	2.05	0.97	5.81	0.00**
Attachment Avoidance	3.62	1.42	1.96	0.74	4.00	0.00**

***p* < .01, **p* < .05; all two-tailed tests

4.3.3. Hypothesis 3 Analysis

The third hypothesis predicted that patients with BPD would report greater negative affect, as measured by subjective ratings of rejection and anger, than controls during the Cyberball task. Rating response naturally varied depending on the inclusion condition associated with the response. Since this was not a linear relationship, exponential curves were calculated for each participant's response, yielding individual and group mean scale and decay variables for rejection (Figure 2) and anger (Figure 3) responses to social exclusion. The scale variable characterizes the scaling factor for the exponential relationship and the decay variable signifies the rate of change in the relationship between behavioral response rating and inclusion condition (i.e., decay). Together these two variables specify the shape and magnitude of the exponential decay rate and thus represent the psychophysical properties of participant behavioral response. Change in probability of inclusion thus corresponds to a change in behavior (i.e., rating).

Rather than analyze response data for each of the inclusion conditions (i.e., 10%, 20%, 40%, 50%, 60%), scale and decay values effectively reduced the data and captured the dynamic relationship between response rating and inclusion condition. This approach effectively increases power and decreases the false positive rate (e.g., compared to conducting a t-test between groups for all five inclusion conditions).

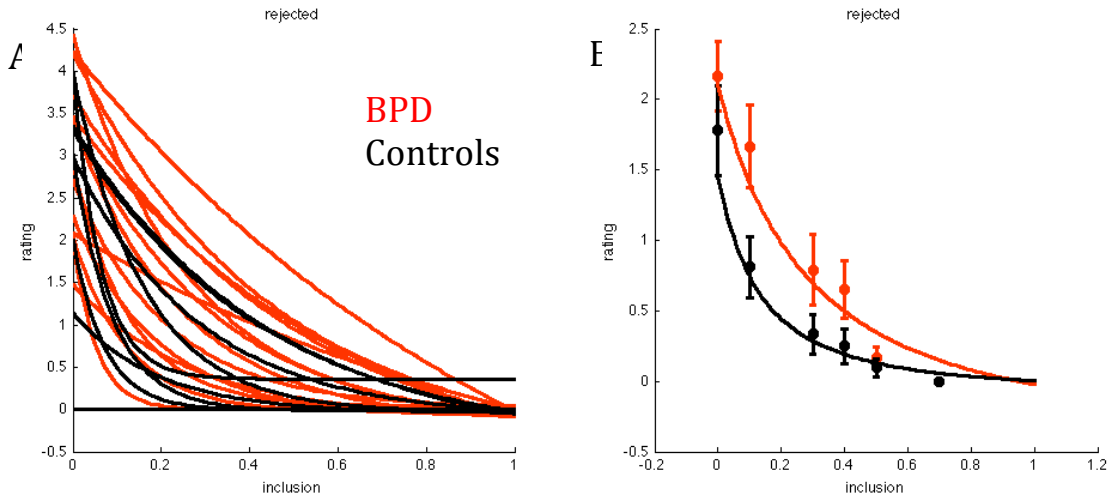


Figure 2. *Cyberball Rejection Ratings by Percent Inclusion.* (A) Exponential functions of rejection ratings for every participant. (B) The BPD group showed a significantly higher mean for rejection scale and decay for exclusion events than non-clinical controls. A subset of these individuals completed the ORI and make up the current sample for this study for which there was a significant group difference between the BPD group and non-clinical controls for only the anger scale (see Table 8).

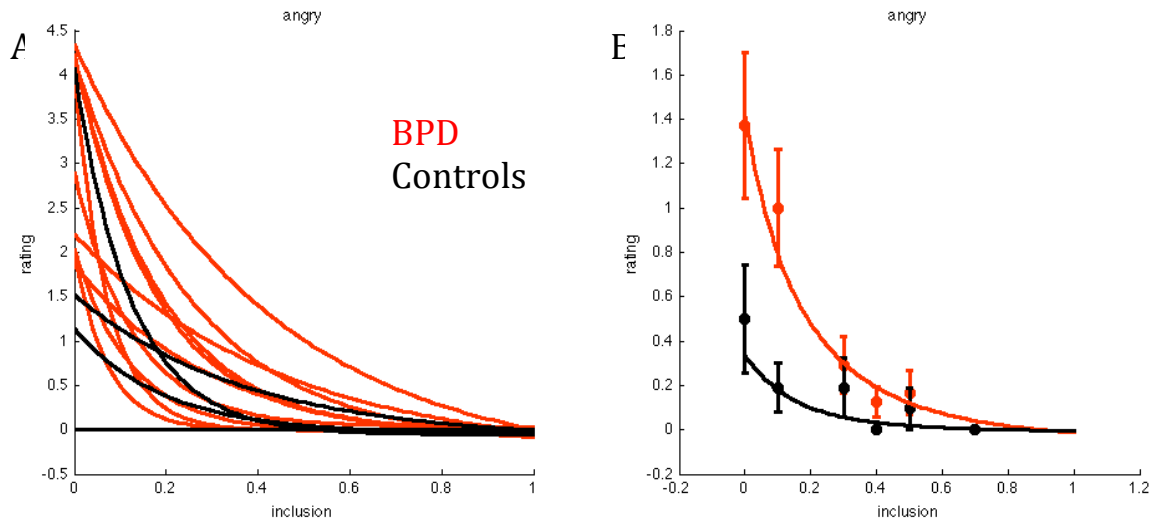


Figure 3. *Cyberball Anger Ratings by Percent Inclusion.* (A) Exponential functions of anger ratings for every participant. (B) The BPD group showed a significantly higher mean for anger scale and decay for exclusion events than non-clinical controls.

Consistent with figure 2, a subset of these individuals completed the ORI and make up the current sample for this study for which there was a significant group difference between the BPD group and non-clinical controls for only the anger scale (see Table 8).

An independent samples t-test was conducted to determine whether the BPD group reported greater negative affect, as measured by subjective ratings of rejection and anger, than controls during the Cyberball task (Table 8). There was a significant difference between BPD and control groups only for the anger scale variable (BPD: $M=1.14$, $SD=1.69$; control: $M=0.19$, $SD=0.50$; $t(27)=2.09$, $p=0.047$), but not for the rejection scale (BPD: $M=1.90$, $SD=1.73$; control: $M=1.44$, $SD=1.59$; $t(27)=0.75$, $p=0.459$), rejection decay (BPD: $M=0.21$, $SD=0.31$; control: $M=0.12$, $SD=0.16$; $t(27)=1.02$, $p=0.316$), or anger decay (BPD: $M=0.08$, $SD=0.14$; control: $M=0.04$, $SD=0.10$; $t(27)=0.91$, $p=0.370$).

Table 8. *Rejection and Anger Rating Response Scale and Decay Variables for Cyberball*

	BPD (<i>n</i> = 14)		Controls (<i>n</i> = 15)		<i>t</i>	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Rejection Scale	1.90	1.73	1.44	1.59	0.75	.459
Rejection Decay	0.21	0.31	0.12	0.16	1.02	.316
Anger Scale	1.14	1.69	0.19	0.50	2.09	.047*
Anger Decay	0.08	0.14	0.04	0.10	0.91	.370

***p* < .01, **p* < .05; all two-tailed tests

4.3.4. Hypothesis 4 Analysis

Simple linear regressions were computed for each of the D-R score variables (see Table 6 above for variable index) to investigate whether developmental quality of differentiation-relatedness of object representations predicted negative affective responses (rejection and anger) to social exclusion during the Cyberball task (Tables 9-12). Assumptions of linearity and normal distribution were checked and met (Figures 4-7). There were four D-R scores that significantly predicted the anger scale value, but none predicted the rejection scale or decay or anger decay responses.

First, the D-R Overall Mean score (*M*=6.02, *SD*=0.56) significantly predicted anger scale (*M*=0.65, *SD*=1.30), $F(1, 26)=4.30$, $p<.05$, adjusted $R^2=.11$ (Table 9). According to Cohen (1988) this is a small effect size. The beta weights, presented in Table 9, indicate that when the Overall Mean score increases by one unit, anger scale decreases by 0.89 units.

Table 9. Simple Linear Regression Analysis Summary for D-R Overall Mean Score
Predicting Anger Scale (N=28)

Variable	B	SEB	β
D-R Overall Mean Score	-0.89	0.43	-0.38*
Constant	6.03	2.59	

Note. $R^2=.11$; $F(1, 26)=4.30$, $p < .05$

* $p < .05$.

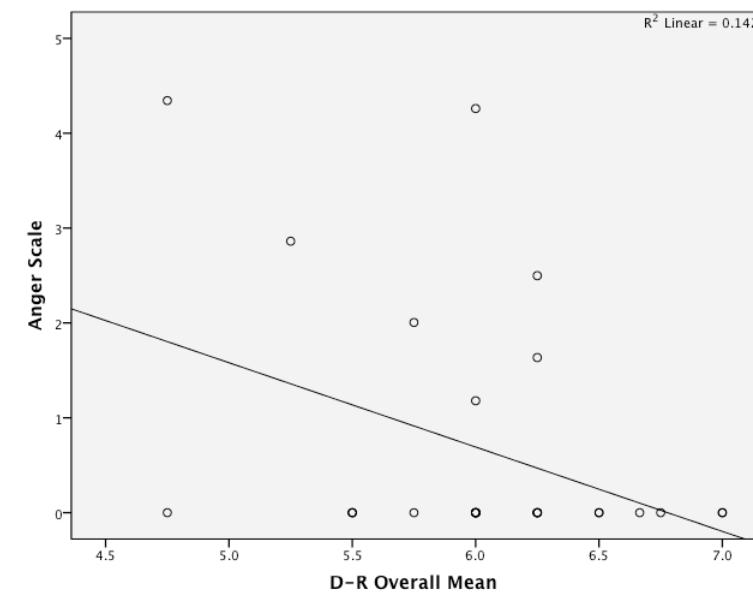


Figure 4. Scatterplot for Anger Scale by D-R Overall Mean

Second, the D-R Father Overall score ($M=5.89$, $SD=0.88$) significantly predicted anger scale ($M=0.67$, $SD=1.32$), $F(1, 26)=10.05$, $p<.01$, adjusted $R^2=.25$ (Table 10).

According to Cohen (1988) this is a small effect size. The beta weights, presented in Table 10, indicate that when the Father Overall score increases by one unit, anger scale decreases by 0.79 units.

Table 10. Simple Linear Regression Analysis Summary for D-R Father Overall Score
Predicting Anger Scale (N=28)

Variable	<i>B</i>	<i>SEB</i>	β
D-R Father Overall Score	-0.79	0.25	-0.53**
Constant	5.35	1.50	

Note. $R^2=.25$; $F(1, 26)=10.05$, $p < .01$

** $p < .01$.

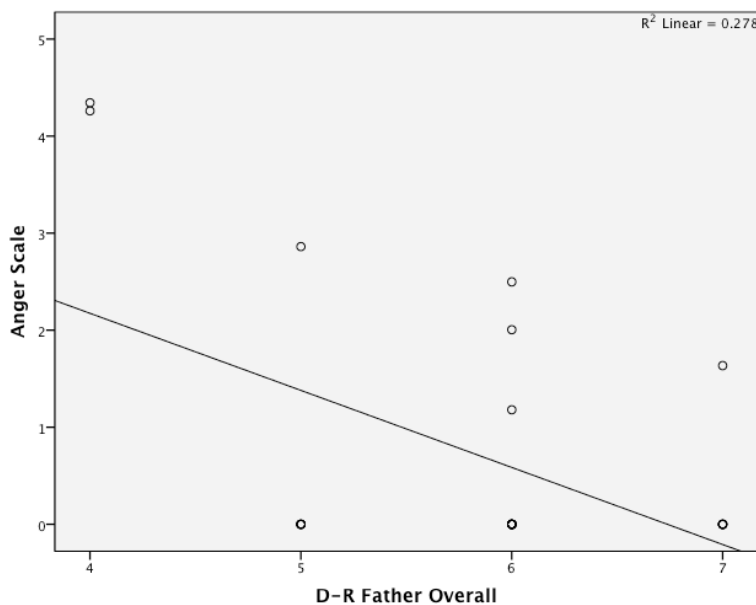


Figure 5. Scatterplot for Anger Scale by D-R Father Overall Score

Third, the D-R Self Overall score ($M=6.07$, $SD=0.60$) significantly predicted anger scale ($M=0.67$, $SD=1.32$), $F(1, 26)=4.88$, $p<.05$, adjusted $R^2=.13$ (Table 11).

According to Cohen (1988) this is a small effect size. The beta weights, presented in Table 11, indicate that when the Self Overall score increases by one unit, anger scale decreases by 0.87 units.

Table 11. Simple Linear Regression Analysis Summary for D-R Self Overall Score
Predicting Anger Scale (N=28)

Variable	B	SEB	β
D-R Self Overall Score	-0.87	0.39	-0.40*
Constant	5.94	2.40	

Note. $R^2=.13$; $F(1, 26)=4.88$, $p < .05$
* $p < .05$.

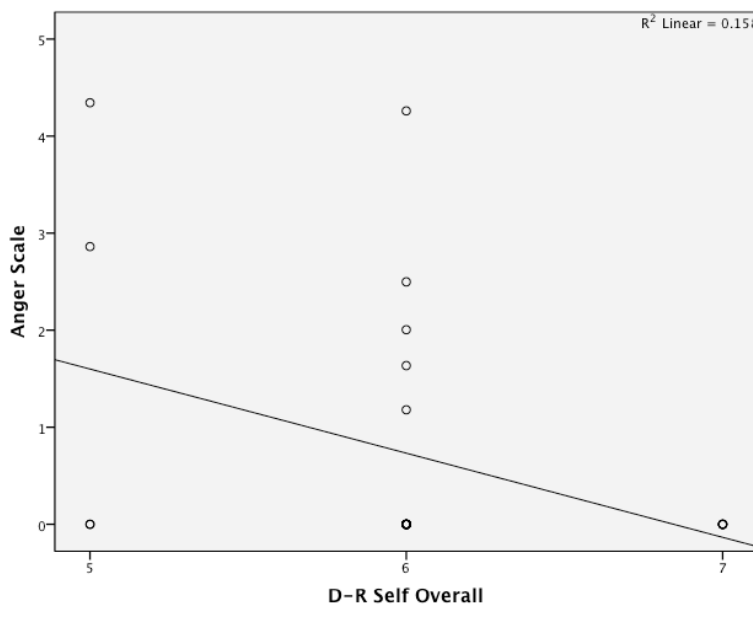


Figure 6. Scatterplot for Anger Scale by D-R Self Overall Score

Fourth, the only low D-R score that predicted the Cyberball anger scale response was the low score for ‘father’. The D-R Father Low score (M=5.41, SD=0.81) significantly predicted anger scale (M=0.67, SD=1.32), $F(1, 26)=4.75$, $p < .05$, adjusted $R^2=.12$ (Table 12). According to Cohen (1988) this is a small effect size. The beta weights, presented in Table 12, indicate that when the Father Low score increases by one unit, anger scale decreases by 0.64 units.

Table 12. Simple Linear Regression Analysis Summary for D-R Father Low Score

Predicting Anger Scale (N=28)

Variable	<i>B</i>	<i>SEB</i>	β
D-R Father Low Score	-0.64	0.29	-0.39*
Constant	4.12	1.60	

Note. $R^2=.12$; $F(1, 26)=4.75$, $p < .05$

* $p < .05$.

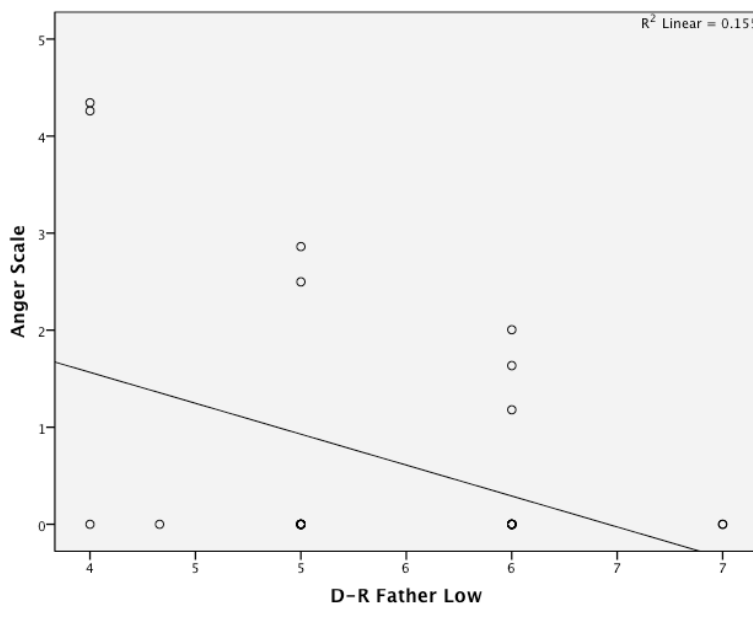


Figure 7. Scatterplot for Anger Scale by D-R Father Low Score

All significant regression findings are summarized in the table below (Table 13). Among the four significant findings for D-R score predictions of the scale score for anger response to social exclusion during Cyberball, the ‘father’ overall score is the most significant predictor with the largest effect size.

Table 13. Summary of Regression Results for D-R Predicting Anger Scale (N=28)

Variable	<i>df</i>	<i>F</i>	<i>p</i>	<i>Adjusted R²</i>
D-R Overall Mean	26	4.30	.048*	0.11
D-R Father Overall	26	10.05	.004**	0.25
D-R Self Overall	26	4.88	.036*	0.13
D-R Father Low	26	4.75	.038*	0.12

***p* < .01, **p* < .05; all two-tailed tests

4.3.5. Hypothesis 5 Analysis

Simple linear regressions were computed for attachment anxiety and attachment avoidance scores to investigate whether attachment style predicted negative affective responses (rejection and anger) to social exclusion during the Cyberball task.

Assumptions of linearity and normal distribution were checked and met. Attachment avoidance did not predict rejection or anger responses from Cyberball. Although attachment anxiety (M=3.17, SD=1.59) did not significantly predict the rejection decay or anger decay responses, it did show a trend toward predicting both the rejection response scale (M=1.66, SD=1.65), $F(1, 27)=3.33$, $p=.079$, adjusted $R^2=.08$ (Table 14), and anger response scale (M=0.65, SD=1.30), $F(1, 27)=3.98$, $p=.056$, adjusted $R^2=.10$ (Table 15). According to Cohen (1988) these are both small effect sizes. The beta weights indicate that when the attachment anxiety score increases by one unit, rejection scale increases by 0.34 units (Table 14).

Table 14. *Simple Linear Regression Analysis Summary for Attachment Anxiety*

Predicting Rejection Scale (N=29)

Variable	<i>B</i>	<i>SEB</i>	β
Attachment Anxiety	0.34	0.19	0.33
Constant	0.57	0.67	

Note. $R^2=.08$; $F(1, 27)=3.33$, $p < .10$

The beta weights in Table 15 show that when the attachment anxiety score increases by one unit, anger scale increases by 0.29 units.

Table 15. *Simple Linear Regression Analysis Summary for Attachment Anxiety*

Predicting Anger Scale (N=29)

Variable	<i>B</i>	<i>SEB</i>	β
Attachment Anxiety	0.29	0.15	0.36
Constant	-0.28	0.52	

Note. $R^2=.10$; $F(1, 27)=3.98$, $p < .10$

Therefore a non-significant positive correlation between attachment anxiety, but not attachment avoidance, and both rejection and anger response scales was found. Thus hypothesis 5 was not confirmed.

4.3.6. Hypothesis 6 Analysis

For each functional run, a regression model was created using three regressors. Each regressor consisted of a series of boxcars with duration equal to 0.4 sec and an inter-trial interval of 1.5-5.0 sec, uniformly distributed. Each regressor was convolved with a custom HRF, estimated for each subject from the visual cortex using an

independent localizer scan. All data was registered to MNI152 standard space using both linear (FLIRT) and non-linear (FNIRT) transforms. A fixed effects (within subject) analysis was performed across the five runs. A mixed effects (between subjects) analysis was performed for the inclusion and exclusion events, explicitly modeling the group, D-R overall mean, attachment anxiety, and attachment avoidance for each subject.

Analysis was performed on data from all 28 subjects who completed both the ORI and ECR. The hierarchical regression included three levels of regressors. The first level analysis modeled inclusion events, exclusion events, and button press motor response (i.e., throws). At the second level (within-subject group analysis across five runs), there were two regressors: the mean effect for each of the first level regressors and an inclusion probability modulator for each of the first level regressors. At the third level (between-subject group analysis), there were five regressors. These were (1) mean of control group (for inclusion event), (2) mean of patient group (for inclusion event), and three modulators: (3) D-R overall mean, (4) ECR anxiety, and (5) ECR avoidance. Each of these third level regressors was applied to both second level inputs. The group analysis modeled the mean effects and also included D-R, ECR attachment anxiety, and attachment avoidance.

Inclusion and exclusion means were calculated using all inclusion (ball throw to subject) or exclusion (ball passed between the two other players) events respectively across conditions of the Cyberball task. For mean response to social inclusion during the Cyberball task, greater D-R Overall Mean score modulated increased activation in the left inferior frontal cortex (Figure 8). However, D-R did not modulate activity associated with exclusion events. Attachment anxiety and avoidance did not modulate neural

activity associated with either inclusion or exclusion events. In sum, specific activation patterns associated with D-R were found, but not in the regions anticipated in accordance with findings from prior research. Furthermore, the modulation effect of D-R, but not ECR, on neural activation parallels the findings that D-R predicts affective response to social exclusion.

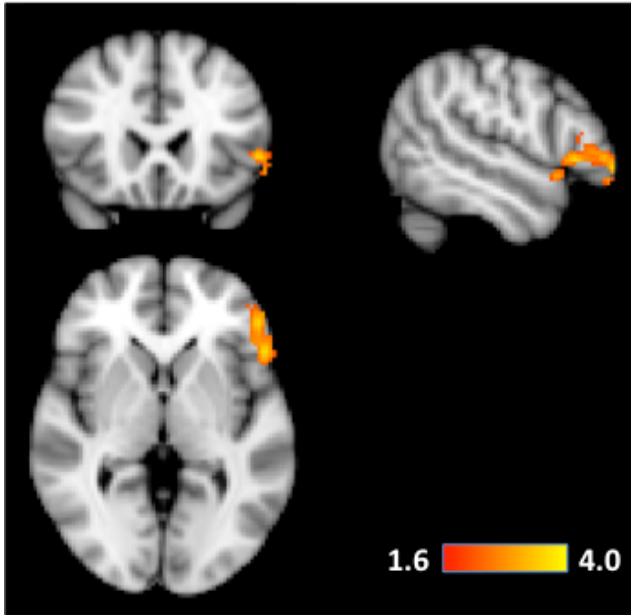


Figure 8. *D-R Overall Mean Modulates Neural Activation for Social Inclusion*

For mean response to *inclusion* during the Cyberball task, D-R Overall Mean score modulated activation in the left inferior frontal cortex.

4.4. Summary of Results

Hypothesis 1 was supported: Comparison of observed means for each of the D-R variables revealed that the BPD group scores were lower than those of non-clinical controls. Participants with BPD showed significantly lower developmental quality of object relations than non-clinical controls for mean overall and mean low scores as well

as overall and low scores for ‘father’ and ‘self’. However, not all comparisons were significant in that father and self scores were significant.

Hypothesis 2 was supported: Group comparison showed that participants diagnosed with BPD had significantly greater levels of attachment anxiety and avoidance than non-clinical controls.

Hypothesis 3 was partially supported: Group comparisons for rejection scale and decay and anger scale and decay showed that BPD had higher mean scores for all four social exclusion variables, but only the comparison for anger scale was statistically significant.

Hypothesis 4 was partially supported: Differentiation-relatedness overall mean, father and self overall, and father low scores negatively and significantly predicted the anger scale outcome from Cyberball. Among these four significant findings, father overall score was the most significant predictor with the largest effect size.

Hypothesis 5 was not supported: Self-reported attachment avoidance was not a significant predictor of negative affective response to social exclusion. Positive correlations between rejection and anger scale variables and attachment anxiety were observed, but they were not statistically significant.

Hypothesis 6 was partially supported: For mean response to social *inclusion* in Cyberball, D-R Overall Mean score modulated activation in the left inferior frontal cortex.

CHAPTER V

Discussion

5.1. Main Findings

The present study's findings supported primary hypotheses that individuals diagnosed with Borderline Personality Disorder exhibit poorer developmental quality of object representations, greater attachment anxiety and avoidance, higher levels of negative affect in response to social exclusion, and less neural activity modulated by expressive language and reward processing. In other words, the results uphold the study's premise that these are particularly important aspects of functioning in BPD and offer further evidence of pathological processes that are relevant to this disorder at the levels of mental representation, attachment, social cognition, and neural activation.

First, this study demonstrated that, compared to controls, individuals with BPD showed poorer developmental quality of differentiation-relatedness for both mean overall and mean low scores (mean calculation included scores for narrative descriptions of 'mother', 'father', 'self', and 'significant other'). This is consistent with prior studies that showed differences in D-R between patients with BPD and non-clinical controls (D. Diamond et al., 1999; Marziali & Oleniuk, 1990). From this it is evident that a so-called global index of differentiation-relatedness is sufficient for detecting differences in developmental quality of object representations between groups, which has been previously demonstrated and argued to be an effective approach to reducing variables associated with the ORI, since there are multiple prompts and three scores for each (Vermote, 2005). Therefore the mean overall D-R variable was enlisted in the regression analyses that followed (see discussion of those findings below).

Even though the mean overall score was the focus of later analyses, there were significant group differences for descriptions of ‘father’ and ‘self’, but mean group differences for ‘mother’ and ‘significant other’ were not significant. This suggests that the developmental quality of differentiation-relatedness of ‘father’ and ‘self’ objects, but particularly ‘father’ (highly significant, larger effect than for ‘self’), may play a unique role in the intrapsychic structure of patients with borderline personality disorder (see 5.1.1. Commentary on Findings). Previous research, particularly with the Adult Attachment Interview (George, Kaplan, & Main, 1985), has indicated that working models of self in relation to mother is highly predictive of many aspects of psychosocial and cognitive functioning as well as processes of transgenerational transmission in both normal and pathological groups, whereas recent investigations have suggested that working models of self in relation to father are particularly relevant for clinical groups (Steele & Steele, 2008).

Lowyck and colleagues (2013) have reported findings from a sample of patients diagnosed with personality disorders that similarly show a distinct role for the father and self D-R scores. The father score was significantly and negatively correlated with general symptoms, depression severity, and self-injurious behavior. Furthermore, father D-R score was a negative predictor of self-injurious behavior and self D-R score was a negative predictor of problems in interpersonal functioning, as measured by a self-report inventory of interpersonal problems. The authors refer to a paper by Target and Fonagy (2002) in which those authors point out that the father is important for limit-setting and impulse control. These aspects of the father’s influence reflect behavioral implications for the subject without addressing the specific relation between the role of the father and

the patient's speech. Considering that D-R is assessed from five-minute speech samples, which is akin to a free association in that patients are asked to speak freely and without interruption about self and significant others, clinical observation provides invaluable insight for interpreting such findings (see sections 5.1.1. Commentary on Findings and 5.2. Multi-Level Model).

Second, attachment anxiety and avoidance were greater for participants diagnosed with BPD than non-clinical controls. Previous studies have demonstrated the same group difference between BPD and control participants, using the ECR (Bartz et al., 2011; K. N. Levy et al., 2005). More broadly, this is consistent with previous findings that insecure attachment is common among borderline patients and specific evidence of both preoccupied and fearful, i.e. multiple, attachment styles within the same individual patients (Agrawal et al., 2004; Choi-Kain et al., 2009; Fonagy et al., 1996; Kenneth N. Levy et al., 2011; K. N. Levy et al., 2005).

Establishing group differences for differentiation-relatedness of object representations and attachment style brings these findings in line with extant clinical theory and empirical research that claim borderline patients exhibit poor developmental quality of object representations and insecure attachment patterns. However, this merely confirmed expectations at the level of mental representation and still needed to be explored in reference to social exclusion, begging the next logical question of whether D-R or attachment would predict participant affective response to social exclusion in the Cyberball task.

Before the relationships between D-R score and attachment style and negative affective response could be addressed, it was necessary to evaluate whether there were

any mean differences between the clinical and control groups in terms of negative affective response to experiences of social exclusion. Given that there were five separate conditions for the Cyberball task with varying levels of exclusion it was most efficient to use values that singly incorporated the relationship between affective rating and percent inclusion (i.e., frequency of exclusion during a given condition). It is important to highlight that participants from the present study represent a subset of a larger sample, for which rejection and anger ratings from BPD patients were significantly greater in terms of both scale and decay in response to exclusion events.

However, in the present study there was only a significant difference between groups for the anger scale variable, but not for the rejection response. One interpretation of the difference between significant findings for both rejection and anger from the larger sample and only anger in the current study, or why these groups did not significantly differ in terms of experienced rejection, is the limited sample size (see 5.3. Limitations and Further Research). Nevertheless, the anger response was particularly robust in that the significant group difference was retained in the smaller sample of the present study.

This has only been shown in one prior study in which patients with BPD reported significantly greater levels of self-reported anger than non-clinical controls following social exclusion in Cyberball (Staebler, Renneberg, et al., 2011). Interestingly, the absence of a significant difference in rejection response between groups was also reported in one prior study of social exclusion in patients with BPD in which the authors used an adaptation of the Cyberball paradigm (Ruocco et al., 2010). In the original Cyberball paradigm participants responded to several questions after each round, but by Ruocco and colleagues' account of their study it was not clear which responses to the

task were included nor how they were calculated or analyzed. This makes it difficult to interpret their results or compare with the present findings. Further research in this area is needed to clarify the specific reactions of borderline patients to situations of social exclusion and to further establish elegant ways of representing such data. In sum, comparisons between the BPD and control participants are generally consistent with predictions and the prior literature.

The aim of the present study was twofold. As has been discussed, the study investigated the difference between patients diagnosed with BPD and non-clinical controls at the levels of intrapsychic object representation, attachment style, and affective response to social exclusion. However the second more ambitious and exploratory aim was to better understand the impact of (1) mental representation (i.e., differentiation-relatedness of object representation and attachment style), on (2) social cognition (i.e., negative affective response to social exclusion), and (3) patterns of neural activation (review Table 1).

Accordingly, regression analyses were conducted across the entire sample to test hypotheses 4 and 5 to determine the relative strength of developmental quality of object representations and attachment anxiety and avoidance as potential predictors of self-reported affective response to social exclusion. Between these two hypotheses the basic question was: do either D-R or attachment style predict affective response and, if so, which measure (D-R or ECR) is a better predictor of the anger response outcome to social exclusion? The same question was addressed in terms of neural activation patterns, addressed in hypothesis 6. No prior studies have examined the relationship among these types of data.

Mean overall D-R (adjusted $R^2=.11$), father (adjusted $R^2=.25$) and self (adjusted $R^2=.13$) overall, and father low (adjusted $R^2=.12$) D-R scores all significantly predicted the anger scale response, but not the rejection scale or either of the decay variables. Therefore the four D-R score variables that were significant in the regression analyses are consistent with those that were significant in the prior group comparisons. Of the four D-R variables that predicted the anger response, the developmental quality of differentiation-relatedness of the overall father score was the *most* sensitive predictor of affective response to social exclusion. Hence, aside from developmental quality of D-R shown in the overall mean score, the father may play a unique role in the intrapsychic structure of patients with Borderline Personality Disorder. Considering the exceptional strength of the father score as a predictor across both patient and control groups, it is apparent that father D-R also has a particularly salient and relevant relationship to social cognition and affect regulation, more broadly.

Attachment anxiety and avoidance, however, were not significant predictors of either experienced rejection or anger. In sum, the regression analyses revealed that D-R is a better predictor, accounting for a greater amount of variance in the anger scale, of negative affective response to social exclusion than self-report attachment anxiety or avoidance. Speculation about the lack of significant findings, in contrast to those for D-R, will be discussed in the following section.

Lastly, an exploratory analysis of neural activity revealed that D-R Overall Mean score modulated activation in left inferior frontal cortex associated with mean response to social *inclusion* during Cyberball (i.e., D-R positively predicted cortical activation). However, D-R did not modulate neural activity associated with social exclusion.

Attachment anxiety and avoidance, measured by the ECR, did not correspond to any specific neural activity for either social inclusion or exclusion.

Despite ongoing debate over the precise role of the left inferior frontal cortex (which includes Broca's area), there is agreement that activity in this region is associated with linguistic functions (e.g., phonology, morphology, semantics) and supportive cognitive processes, such as memory retrieval and cognitive control (Tyler et al., 2011). Activity in the left inferior frontal cortex is also associated with enhanced naming performance in stroke patients with aphasia, which demonstrates the region's robust capacity for verbal object identification (Holland et al., 2011).

Since those with higher D-R scores (e.g., non-clinical control participants) show enhanced activity in left inferior frontal cortex for social inclusion and lower anger ratings in response to social exclusion, activity in this region associated with social inclusion may have a prophylactic influence on social exclusion. It follows that individuals that exhibit poorer developmental quality of differentiation-relatedness (e.g., patients diagnosed with BPD) may not encode social inclusion information verbally to the same degree as those with higher developmental quality of D-R and are thus more likely to become angry in response to social exclusion (which is consistent with the finding that D-R negatively predicts anger rating in response to exclusion events).

The modulation effect of D-R was found in an analysis that included all participants from the current sample, but lower D-R was also established in the BPD group, compared to controls. Since increased activity in the left inferior frontal cortex is modulated by higher D-R, the activation difference is also reflected in the difference between patients and controls. Furthermore, the significant group difference for D-R

indicates that in the absence of well differentiated, integrated, and modulated mental representations of self and significant others, patients diagnosed with BPD do not benefit as much as non-clinical controls from experiences of social inclusion (less activation in left inferior frontal cortex) or to buffer the negative affects aroused in experiences of social exclusion. In other words, if the argument that inclusion is reinforcing holds, borderline patients experience less reinforcement from social inclusion during experiences of exclusion. Consequently, they are susceptible to intense negative affect as a result of such exclusion.

Comparing developmental quality of differentiation-relatedness from the ORI with attachment anxiety and avoidance from the ECR, D-R proved to be a better predictor of affective response to social exclusion and also moderates neural activity associated with social inclusion, whereas attachment style does not.

5.1.1. Commentary on Findings

Given the novelty of these findings, interpretation of their significance is necessarily modest. One way to proceed with such interpretation is by critically examining differences between the measures and thereby re-situating them in their clinical context. Three fundamental issues are at stake in comparing the ORI with the ECR: (1) the range and difference of objects addressed by each, (2) the relevance of affect, and (3) the inherent clinical value of the five-minute spontaneous speech sample in the ORI.

Although the ECR was developed in part by using attachment models and measures that reflect a broader range of attachment relationships, and in theory an

individual's attachment classification should translate between different types of relationships, this has not been adequately addressed in the ECR literature and is therefore open to speculation. Reports using related attachment instruments have suggested that measures of romantic attachment do not necessarily translate to attachment patterns in other types of relationships, such as with family or friends (Caron, Lafontaine, Bureau, Levesque, & Johnson, 2012; Fraley, Heffernan, Vicary, & Brumbaugh, 2011; Sibley, Fischer, & Liu, 2005). Therefore, it is possible that the mean composite score of descriptions across *multiple* key figures (i.e., D-R overall mean) is more stable and robust compared with the restricted range of the ECR measure, which refers only to romantic relationships. In light of this, it might also be assumed that the ECR's focus on such relationships would merely be analogous to the 'significant other' description from the ORI. However, this did not appear to be the case with correlation coefficients between attachment variables and D-R Significant Other Overall score all falling between -.09 and .02 (none of which were significant). Therefore, any potential role of overlap between the content of the two measures is less likely to be influencing their predictive value than the difference in the range of object relations that are captured by the respective instruments. This is directly supported by the fact that it was D-R mean, father, and self overall scores (i.e., not significant other) that proved most useful in establishing the predictive relationship with affective response.

Beyond basic observation and evaluation of the respective ranges of object relationships addressed by the ORI and ECR, 'father' and 'self' were the only relations that were significant in the group comparison and predicted negative affective response to social exclusion. One of the distinctions between the measures that will be addressed

shortly is that the ORI relies on speech samples whereas the ECR does not, but first the implication of findings for father and self will be discussed.

Lacan, a psychoanalyst who spent nearly half a century addressing the role of patients' speech in treatment, privileged the influence of the father on the individual. He described an essential function at play in speech, which he called the *Name-of-the-Father* (NoF; Lacan, 1993). One of the initial effects of this function is that it protects the child from developing psychosis, but not from neurotic or borderline levels of pathology. As a function, the NoF relates to both the *impact* of the father in supporting the child's social/symbolic maturation process (analogous to high D-R) and to identification between the self and the father (which may also partially account for the significant findings for both self and father).

The NoF is not a specific word (i.e., the actual name), but the property of the patient's speech that organizes his or her experience. Thus the NoF shares in common with D-R that both are vital products of development and both serve to structure experience over the course of one's life. The better the NoF is established, the less the individual suffers from his or her symptoms. Likewise, weakness of the NoF causes the subject to poorly differentiate and over-rely on identifications with others, manifesting in social relations that are both dependent and overly aggressive. This is similar to the influence of developmental quality of differentiation-relatedness insofar as both reflect structured mental representations and buffer intense emotional reactivity. Strong resonance between NoF as a purely clinical concept and D-R as an operationalized measure of object relations (albeit one derived from extensive clinical observation) supports the construct validity of the father and self D-R findings.

Turning to the second of the three issues that were mentioned above, the basic premise of object relations theory is that affect is a vital contingency between self and other. It could be argued that D-R is a better predictor of affective response because—through the clinical lens of object relations—the role of affect in ORI descriptions is more prominent than in the self-report ECR measure of behavior patterns in relationships. Thus it is reasonable to expect that D-R scores from the ORI would be more predictive of responses to social situations, particularly those that involve outright exclusion or rejection by others. The two findings that borderline participants have lower D-R scores than controls and that D-R predicts anger response to social exclusion are consistent with clinical observation and research findings that anger/aggression plays a central role in the affective dimension of relationships of patients with BPD, and further that it is linked to impaired mental representations (S.J. Blatt & Auerbach, 2001; J.F. Clarkin et al., 2006; O. Kernberg, 2004; Staebler, Helbing, et al., 2011).

For example, in the report of their study of mental representations in which they used D-R to score ORI speech samples from patients with BPD, Blatt and Auerbach (2001) write,

In her admission description of her father, C. gave no indication of ambivalent feelings. Only anger and rage were present...she was unable to modulate her anger over what she regarded as her father's intrusive domination...C. relied defensively on sexualized anger to ward off deeper concerns with nurturance and dependence" (p. 144).

This is a striking example of anger as an impediment between the patient and significant other, serving as a splitting defense against relying or depending on the other.

Paradoxically, conflicts and ruptures produced by emotional volatility actually make patients with BPD more dependent on others because they are unable to adequately

internalize at the representational level (since they have not been able to separate and preserve a healthy distance from significant others). In other words, this failure of object constancy requires frequent reassurance of the object's presence that involves self-perpetuating repetitions of rejection, paired with intense anger. Considering what Blatt and Auerbach describe in the context of the present neural findings, it is clear that such characteristic intense anger is concomitant with hypoactivation of expressive language. As such, anger and aggression become an entrenched, polarized defense against anticipated or perceived rejection just as borderline patients showed poorer quality of D-R and greater anger response to social exclusion than controls in the present sample.

Lastly, unlike self-reported attachment style, D-R scores relied on five-minute speech samples. From the vantage point of the empirical literature, which is primarily comprised of self-reports and experimental manipulations, it is not readily apparent why the speech itself is important. In fact, access to the patient's speech—that one argues is an embodied/affective speech—is the precise advantage of incorporating a measure derived from psychoanalytic theory into the design of the study and interpretation of its findings. In this way the speech samples from the ORI interview resonate with—but are not the same as—speech in psychodynamic clinical interviews, as conducted in actual clinical practice. Not only does the patient's speech provide a clinically relevant framework for understanding participants' responses to social exclusion, it functions literally as the only common ground between the study and clinical 'reality' itself, insofar as clinical 'reality' is about hearing and interpreting what the patient says (see section 5.2. Multi-Level Model).

Finally, the unique influence of differentiation-relatedness also manifests at the level of neural activation. Given that activation in left inferior frontal cortex was modulated by narrative properties of speech samples, it is possible that those with higher D-R are better able to engage linguistic processes (reflected by the activation pattern) during social inclusion. This would suggest that historically relevant “inclusion events” experienced with significant others are verbally encoded and continue to influence current responses to social interactions. Therefore, developmental quality of differentiation-relatedness is implicated in one’s capacity for narrative construction and integration of novel social experiences (e.g., internalizing “good objects”).

The neural activation finding also indicates the way in which this region-specific activation during social inclusion is protective in the context of social exclusion, particularly for non-clinical controls with high D-R. For these individuals, social inclusion reinforces already stable and reliable object relations schemas that are consequently less susceptible to the threat of exclusion or rejection by others. From this perspective, social inclusion may be understood as a reinforcement of linguistically mediated object representations that predate the inclusion event in the here-and-now and taps into both the symbolic-linguistic and physiological levels of experience.

On the other hand, individuals with BPD typically enter social inclusion events with mental representations colored by past rejection experiences, expectation and anticipation of rejection, and poor affect regulation, none of which are effectively mediated by higher order linguistic processes inherent in higher levels of differentiation-relatedness. Thus borderline patients’ characteristic negative affective sensitivity to

social exclusion points to hypoactivation of the left inferior frontal cortex during inclusion events.

These findings have implications for the treatment of borderline pathology. In a randomized control trial of different treatments for BPD, only Transference Focused Psychotherapy (TFP), a psychodynamic treatment based on object relations theory, led to improvements in personality organization, which was associated with narrative coherence and reflective function, as measured by the Adult Attachment Interview (John F. Clarkin, Levy, Lenzenweger, & Kernberg, 2004; Kenneth N. Levy et al., 2006). Specifically, narrative coherence reflects the participant's capacity to amplify their general descriptors of relationships with primary attachment figures with specific memories or examples of experiences that reasonably and credibly support their characterization of those figures. Coherence refers to the degree of credibility and level of organization of the narrative regardless of how positively or negatively attachment figures are portrayed. Hence it refers to one of the most salient aspects of the patient's narrative in that attachment classification (i.e., secure or insecure) relies heavily on the quality and consistency of coherence. In fact, the AAI subscale of narrative coherence is the best predictor of attachment security among the AAI subscales (Waters et al., 2001).

The role of narrative coherence is particularly relevant given the results from the present study that show a unique relationship between developmental quality of narratives and affective reactions to social exclusion. One could speculate that the coherence of AAI narratives may also relate to affective response to social exclusion and the regional neural activation during social inclusion, associated with linguistic

functioning. This hypothesis will be explored in future research with the AAI, which has been administered to this sample and awaits analysis.

Current findings with the ORI suggest the importance of targeting expressive language and symbolization of inclusive experiences in BPD. Based on the findings from the RCT on change in borderline patients after one year of TFP versus two other treatments (DBT and supportive therapy) one would expect that their D-R scores would improve in parallel with narrative coherence and reflective function and that TFP might be the preferred treatment in this respect. In fact, in the RCT the change in D-R scores paralleled change in attachment and RF. Furthermore, change in quality of D-R was greater in patients with greater attachment security and RF in the patient-therapist relationship (D. Diamond et al., 1999). The finding from the present study that the D-R mean score modulated neural activity in the left inferior frontal cortex associated with social inclusion raises the important question of what to focus on in therapeutic and other relationships, and what constellation of transference/countertransference work might enhance borderline patients' ability to internalize positive experience with others ("good objects"). Further investigation is needed to begin to tease out the relationship between benign, integrated mental representations and capacity to benefit from positive experiences with others.

5.2. Multi-Level Model

The findings from this study support the rationale for using a multi-level design and provide evidence of its advantages over conventional alternatives. It was shown that developmental quality of differentiation-relatedness in speech samples is predictive of

emotional response to novel social interactions in a laboratory setting. Furthermore, D-R moderated the neural activation associated with social inclusion. These results are the first to demonstrate the advantages of such an experimental design for understanding the relationship among different levels of psychopathology. While other studies have connected mental representations of attachment with neural findings (cf. Buchheim et al., 2008), none have looked at the interrelation of all three levels of analysis. By analyzing multiple levels together, complexities were discovered that might have otherwise been obscured.

The multi-level aspect of this study was introduced earlier as a logical synthesis of theoretical and methodological approaches that relate to the same psychopathology, which in this case was Borderline Personality Disorder (see 2.5. A Multi-Level Approach). There is ample support from the empirical literature to justify such a clinical investigation using an experimental design. However, in any experiment it is challenging to retain information that is actually clinically relevant in a more direct sense. Even the ECR, a well-established self-report measure of attachment behavior, could be considered a reductionist operationalization of the more conceptually and clinically complex phenomenon of attachment. Nevertheless, despite inherent difficulties in developing measures of complex clinical phenomena, this study supports the notion that it is possible and crucial to advancing clinical theories.

Clearly all the aforementioned levels of observation are essential to this model. But perhaps the model is most unique because it preserves a certain clinical integrity, in its use of the patient's speech sample. Unfortunately data from speech samples has rarely

been integrated with the other two levels of data, which are exclusively collected through laboratory and neuroscience research.

Lacan writes “what at the outset is natural or biological does not cease to find a reference on the symbolic plane, where it is a matter of subjective assumption, in that the subject herself is caught in the symbolic chain” (Lacan, 1994, p. 100). This suggests that speech is always the mediator between physiological processes and social encounters. One implication of this view, in the context of the present argument and findings supporting the rationale for using a multi-level model, is that any clinical research that omits patient’s speech runs a risk of missing a crucial level from which to understand any given psychopathological process. For this reason, psychiatric research, including social cognitive neuroscience research, can benefit from using measures that assess patient speech. While this idea is generally accepted in the field of clinical practice, it is a more novel consideration for those working from an experimental research perspective. Ultimately Lacan’s qualitative observation converges with lessons from this model’s quantitative approach in that both resist prevalent reductionist ways of measuring and understanding clinical symptomatology.

An effective way of resisting such reductionist tendencies is by exploring psychopathology through both clinical and research practices and seeking creative means of bringing these practices into a mutual dialogue, while respecting their respective differences (Sidney J. Blatt, Corveleyn, & Luyten, 2006). The study’s mixed-methods design was precisely inspired by this desire to respect the distinct domains of clinical reality and experimental research while staging a dialogue between the two. This effort produced findings that achieve just that; the present study demonstrates that

differentiation-relatedness is a particularly useful way of analyzing patient's speech in a laboratory setting and is meaningfully associated with current social interactions as well as neural activation. This poses a compelling argument for further application of similar multi-level research designs.

Lacan eventually substituted the function of the Name-of-the-Father with the *sinthome* (Greek for symptom), a term that allowed him to better conceptualize the way each subject organizes, or binds together, speech, social identifications, and the body (Lacan, 2005). In other words, what was first identified in speech (NoF) transcends speech in the way it links (*sinthome*) the different levels addressed in the present study: mental representations/speech, social relations, and affective and neural response. Thus the transition from the Name-of-the-Father to *sinthome* provides a trajectory to help make sense of the present findings: (1) the father holds a crucial role in the psychological life of the individual and (2) the *sinthome* inherits the role of the father insofar as it connects key dimensions of experience in a purely unique way for each subject. The second point suggests that there is an entirely individual dimension of the subject that can only be taken up in the clinical relationship and is perhaps beyond the purview of experimental methods because it is precisely singular/individual and not replicable (Bassols, 2014; <http://miquelbassols.blogspot.fr/2014/03/psychoanalysis-science-and-real.html>). But the present study challenges previous distinctions between clinical practice and research by pushing the scope of both in considering multiple levels within the same frame.

Though the present study breaks new ground, it evokes Bucci's *Multiple Code Theory*, an approach to research that is rooted in both psychoanalysis and cognitive science (Bucci, 1997). Her explanation of information representation and processing, and

even her qualitative measure of Referential Activity, resonate with the mixed-methods paradigm used in this study. To address the task of psychoanalysis as it applies to the empirical sciences, she writes,

The model that is developed for psychoanalysis and informed by psychoanalysis must, however, go beyond the models of cognitive science, as we have them today, in laying greater emphasis on representations and processes associated with emotion and with somatic functions, in order to retain the dynamic concepts with which psychoanalysis is concerned (Bucci, 1994, p. 242).

This “going beyond the models of cognitive science” is precisely what was achieved by the present study as it constitutes an initial effort to elucidate the complex relationship between mental representation, particularly in the form of linguistic-symbolic processes, and affective and neural responses (Bucci divides these into verbal, nonverbal symbolic and nonsymbolic systems) in individuals diagnosed borderline personality disorder.

The findings from this study also indicate that the multi-level approach can enhance future research in social cognitive neuroscience and possibly research in related fields that study psychiatric disorders. Including mental representation measures, and especially using speech samples, provides a vital individual context for present social interaction and neural activation that is both historically and developmentally relevant. From a clinical perspective, this information constitutes an essential context to social, behavioral, and neural responses that would otherwise be impossible to attribute any personal meaning to. Likewise, psychodynamic object relations models can benefit from these experimental findings because isolating specific constructs (e.g., feelings of rejection and anger) is part of a broader endeavor to further differentiate and clarify the specific influence of different forms of mental representations and how they are affected by current social exchanges. Future studies may be designed to look at the change in

affective and neural responses to social encounters, as a function of psychodynamic treatments that address patients' prominent object relations patterns.

5.3. Limitations and Further Research

The discussion of limitations in this dissertation is organized into two parts. The first section discusses the limitations of effect size and power within the study. Next, the importance of replication and the need to expand on multi-level research with other clinical samples is considered.

A significant limitation of the present study was the sample size. Across all three measures of interpersonal functioning, group differences were evident in the predicted directions, but not all of them were significant. Thus, developmental quality of object representations, measured by D-R scores from the ORI, was uniformly lower for borderline participants than controls, however comparisons for only six out of 15 D-R score variables were significant. This limitation is mitigated by two aspects of the significant differences that were found: (1) the significant difference between the mean overall and low scores of the groups represent the most global index of developmental quality of object representation, and (2) four of the six significant findings were consistent with respect to object, i.e., 'father' and 'self'. Although these findings were associated with small effect sizes, it was still remarkable that they overcame the challenges in power presented by the number of participants.

This is in contrast with results from the ECR, which showed the expected relationship between attachment anxiety and rejection and anger responses to social exclusion, but these failed to reach significance. However attachment avoidance did not

approach significance, which suggests that attachment anxiety might be a more sensitive predictor for negative affective response to social exclusion. Again, this is consistent with previous research that links BPD to insecure attachment patterns characterized by anxiety, such as preoccupied and fearful attachment (Choi-Kain et al., 2009; Kenneth N. Levy et al., 2011). It is likely that attachment anxiety would reach statistical significance in a larger research sample. The same appeared to be true for negative affective responses to social exclusion, considering there were significant group differences in the larger study sample, but only one significant group difference for anger scale in the present sample. As such, future inquiry may help to examine these associations and predictive relationships that exist between multiple levels of pathology in Borderline Personality Disorder.

Another limitation was that the ECR might not have offered a sufficient reflection of attachment to adequately compare with the ORI data. For example, there was a considerable contrast between the ranges of relationships identified by each of these measures. Specifically, the ECR focus on romantic relationships may have been too narrow a reflection of attachment. Other interview based attachment measures, such as the Adult Attachment Interview (AAI), are more evenly matched with the ORI both in their attention to the relationship between the self and one's parents, and in their capacity to index or assess working models of self in relation to attachment figures.

On the other hand, perhaps the most parsimonious conclusion to draw from the lack of findings from the ECR is that it does not rely on the participants' speech as the AAI and ORI do. In line with the conclusions drawn from the findings of the present study it could be assumed that the speech sample is essential for detecting such nuanced

features of the pathology related to (insecure) internal working models of attachment, at the narrative level. This is another reason why the AAI would offer another within method (narrative sample) comparison with the ORI. Nevertheless, the present design afforded a valuable opportunity to compare narrative and self-report data of clinically relevant information.

A similar limitation was observed among group comparisons of negative affect responses from Cyberball. Participants included in the present study represented a subset of a larger sample (BPD: $N = 24$; Control: $N = 21$) in which significant group differences for all (four) rejection and anger response variables were significant. This suggests that the rejection ratings and anger decay rating would have been significant in the direction of the hypothesis of the present study—that both rejection and anger ratings would be greater for borderline participants than non-clinical controls.

Furthermore, the scatterplots reflect regression estimates that justify use of linear models, but fall somewhat short of their potential due to several of the anger scale values being equal to '0'. This suggests that a limitation in the experimental design may have been that the experience of social exclusion was not sufficiently evocative for many participants. One reason may be that the BPD group was not selected from an inpatient population and thus their affective responses were more comparable to those of controls. Another reason may be the lack of interaction or social cues from the other players in the Cyberball game. One imagines that this contributes to participants experiencing a lack of stimulation in the scanner during the task that may lead some of them to more neutral or disaffected response patterns.

Considering this is the first study to carry out the proposed multi-level approach, there is a need for replication. Given the present promising results, it is recommended that D-R scores from the ORI be used in future research. Other tools for assessing narrative data and other self-report measures may be explored alongside such narrative measures. These results certainly reflect the role of differentiation-relatedness as it pertains to BPD, but it would also be worthwhile to apply the multi-level model to other psychiatric populations. Thus further research is needed in all of these areas.

5.4. Conclusion

The primary aim of this study was to confirm prior findings with respect to distinct patterns of pathology in a group of individuals diagnosed with Borderline Personality Disorder and to enhance understanding of the different levels of processes that are at play in borderline pathology. This study yielded several significant findings at the levels of mental representation, social cognition, and neural activation with respect to group differences between borderline and non-clinical controls. Significant predictive relationships between these measures of interpersonal functioning and neural activation were also discovered. Future studies using similar multi-level models are recommended in order to maintain a bridge between clinically relevant material and experimental design that is able to address the complexity of the clinical picture under investigation.

APPENDIX A

The D-R Scale (Diamond, Blatt, Stayner, & Kaslow, 1993b)

The 10 developmental levels of self- and other-representations are as follows:

1. Self-other boundary compromise
Basic physical cohesion or integrity of representations is compromised
2. Self-other boundary confusion
Self and other are represented as physically intact, but feelings and thoughts are amorphous, undifferentiated or confused.
3. Self-other mirroring
Consolidation and stabilization of representations based on mirroring or perception of similarity
4. Self-other idealization or denigration
Consolidation and stabilization of representations based on unitary, unmodulated idealization or denigration
5. Semi-differentiation
Tenuous, semi-differentiated consolidation of representations achieved through an oscillation between positive and negative attributes and qualities or by a rigid adherence to concrete properties to achieve a tenuous cohesion.
6. Emergent, ambivalent constancy and cohesion and an emergent sense of relatedness
7. Consolidated, differentiated, constant (stable) representation of self and others in essentially unidirectional relationships
8. Cohesive, individuated, empathically related self and other in bidirectional relationships
9. Differentiated, individuated, stable representations of self and others in reciprocal relationships
10. Reflectively constructed integrated representation in reciprocal and mutual relationships with explicit recognition and appreciation of the intersubjective process of constructing meaning, as well as of the relational matrices that contribute to this process.

35. It bothers me when I have to rely on my partner for something.

Strongly Disagree

1

2

3

4

5

Strongly Agree

6

7

36. I am always happy to see my partner after a short separation.

Strongly Disagree

1

2

3

4

5

Strongly Agree

6

7

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