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Longitudinal Validation and Diagnostic Accuracy of the Minnesota Borderline Personality Disorder Scale (MBPD)

Elizabeth Rojas
University of South Florida, ecrojas@mail.usf.edu

Longitudinal Validation and Diagnostic Accuracy of the Minnesota Borderline Personality Disorder Scale (MBPD)

by

Elizabeth C. Rojas

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Major Professor: Marina A. Bornovalova, Ph.D.
Cindy Cimino, Ph.D.
Brian M. Hicks, Ph.D.
Stephen Stark, Ph.D.

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Abstract

Borderline Personality Disorder (BPD) has been previously conceptualized as an extreme variant of normal personality traits, captured by continuous indices. A previous study successfully developed and validated a self-report BPD measure, the Minnesota Borderline Personality Disorder Scale (MBPD). I conducted two studies aimed at providing further validation for this measure. Results from Study 1 (clinical sample of substance users) indicated that MBPD exhibited strong positive correlations with measures of convergent validity (self-report and diagnostic measures). Additionally, the MBPD showed similar correlations with external correlates as those of the convergent validity measures, in addition to incremental utility in predicting these external correlates above and beyond negative affect. Third, a Receiver Operating Characteristic (ROC) curve analysis indicated that diagnostic accuracy of the MBPD was excellent for differentiation between BPD and non-BPD individuals. Likewise, Study 2 (non-clinical sample of undergraduate students followed over 6 months) showed strong correlations with an index of convergent validity (self-report measure), similar correlations with external correlates as that of the convergent validity index, and incremental predictive utility. Finally, in this study, the MBPD exhibited high rank-order stability, but significant mean-level and individual-level change over time. These data suggests that these scales are measuring the same latent construct of BPD, providing further evidence for the construct validity of the MBPD.

Longitudinal Validation and Diagnostic Accuracy of the MBPD

Borderline Personality Disorder (BPD) is a personality disorder marked by severe social and functional impairment as well as poor long term outcomes (Skodol, et al., 2005; Whisman & Schonbrun, 2009; Winograd, Cohen, & Chen, 2008). Characteristics of BPD include both maladaptive behvaiors and traits such as emotion dysregulation, outbursts of anger, impulsive and risky behaviors, self-harm, unstable interpersonal relationships, and disturbances in self-image (Linehan, 1993; Links, Heslegrave, Mitton, van Reekum & Patrick 1995; Livesley, Schroeder, & Jackson, 1992; McGue, Osler, & Christensen, 2010; Siever & Davis, 1991; Siever, Torgersen, Gunderson, Livesley, & Kendler, 2002; Skodol et al., 2002a; Skodol et al., 2002b). Moreover BPD is comorbid with other psychopathology including depressive symptoms, (Fonagy & Bateman, 2006; Perry, 1985), anxiety symptoms (Andover, Pepper, Ryabchenko, Orrico, & Gibb, 2005; Zanarini, et al., 1998), disordered eating (Pope & Hudson, 1989; Striegel-Moore, Garvin, Dohm, & Rosenheck, 1999), and both alcohol and substance abuse (Links et al., 1995; Paris, 1997).

Traditionally BPD has been thought of as a categorical (present or absent), “lifetime” disorder. However, recent research has brought three advances in the understanding of BPD. The first is that, far from being a life-long sentence, BPD traits and features fluctuate on both a short-term as well as long-term level. Prior research shows that of those originally with diagnosed BPD in adulthood, only about a third of those met diagnostic criteria over a 1 -3 year follow-up (Paris, Brown, & Nowlis, 1987; Shea, Stout et al., 2002; Zanarini et al., 2003b). Likewise, Bornovalova, Hicks, Iacono, & McGue (2009) showed that BPD features are elevated in mid- and late adolescence, but steeply decline in young adulthood.

The second advance is that BPD is best conceptualized as a continuous construct (Ayers, Haslam, Bernstein, Tryon, & Handelsman, 1999; Edens, Marcus, & Ruiz, 2008; Rothschild, Cleland, Haslam, & Zimmerman, 2003; Wilberg, Urnes, Friis, Pedersen, & Karterud, 1999). For instance, Edens et al. (2008) utilized three taxometric procedures to determine if BPD is taxonic (latent category) or nontaxonic (latent dimension) and found consistently that BPD showed a non-taxonic or more

dimensional conceptualization. And, it is now widely recognized that maladaptive personality traits are expressed in the general population, in the absence of any full-blown disorders, but may nevertheless signal a liability for a forthcoming disorder (Shiner, 2009). From this standpoint, personality disorders are extreme manifestations of underlying continuous dimensions (Shiner, 2009; Rothschild, Cleland, Haslam & Zimmerman, 2003).

The third advance is that research indicates that BPD is best conceptualized as an extreme variant of normal personality features (e.g., Five-Factor Model; FFM; Clarkin, Hull, Cantor, & Sanderson, 1993; Costa & McCrae, 1992; Saulsman & Page, 2004; Trull, Widiger, Lynam, & Costa, 2003). For example, Morey & Zanarini (2000) found that the neuroticism factor of the five-factor model could distinguish between BPD and non-BPD individuals, and that in fact the entire FFM model accounted for a significant proportion of variance in BPD diagnosis for both self-report and diagnostic measures. Further, in three samples, undergraduate students, and two outpatient clinic samples, Trull, Widiger, Lynam, Costa (2003) showed that a derived expert-consensus, prototypic, FFM borderline profile was associated with well-validated diagnostic measures of BPD and theoretical constructs related to BPD.

Taking into account the success of normal personality inventories in capturing abnormal personality disorders, a previous study used the Multidimensional Personality Questionnaire (MPQ, Tellegen, 1982, Patrick, Curtin, & Tellegen, 2002) to create a self-report, continuous measure of BPD, the Minnesota Borderline Personality Disorder Scale (MBPD; Bornovalova, Hicks, Iacono & McGue, 2011). The MBPD is a 19-item scale developed using items from the MPQ (MPQ; Tellegen, 1982; Patrick, Curtin, & Tellegen et al., 2002). Notably, the purpose of the original study was not to develop a “gold standard” of BPD measurement. Instead, the purpose was to capitalize on the richness of existing large datasets in which the MPQ – but, due to expense or participant burden, no measure of BPD was administered. If a valid index of BPD could be calculated from the MPQ, then the data available from large, longitudinal datasets (e.g., Dunedin Multidisciplinary Health Development Study) could be used to answer questions about BPD.

The pragmatics behind the original development purpose notwithstanding, the MBPD showed excellent validity. It was significantly correlated with both diagnostic and self-report, continuous measures of BPD. Moreover, the MBPD provided incremental prediction of BPD symptoms over negative

emotionality, a construct that has considerable overlap with BPD, (Bornovalova et al., 2011; Ball, Tennen, Poling, Kranzler, & Rounsaville, 1997; Trull, 1992) indicating that this measure is not just indexing negative emotionality. Further, the MBPD predicted external correlates of BPD such as substance use and depression (Zanarini & Frankenburg, 1997; Zanarini et al., 1998), reinforcing that this measure exhibits the predicted associations between BPD traits and related external constructs, reflecting the functioning of the latent construct of BPD.

Although this scale has been through a rigorous validation process, a single validation study is insufficient for demonstrating the validity of any measure. A follow-up validation study in independent samples is needed for several reasons. First, cross-validation in independent samples would show that the MBPD measures the same BPD traits independent of site or sample. Second, the original validation study lacked a test of short-term longitudinal stability. Examining the stability of a measure provides further evidence that the scale consistently measures BPD features at varying time points. Third, previous validation studies (Bornovalova et al., 2011; Rojas et al., 2013) have not examined the diagnostic utility of this measure (i.e. the ability of MBPD to differentiate between BPD and non-BPD individuals). Finally, MBPD remained a continuous measure, and to date, no study has attempted to set a diagnostic "cutoff" that allows for identifying individuals with BPD.

The final point – the need for a diagnostic cutoff - stands in contrast to both my view and the wealth of research that indicates that BPD is best conceptualized continuously. However, there are at least three practical reasons to dichotomize a continuous construct. First, having a diagnostic cutoff allows researchers to estimate prevalence rates of BPD in large existing datasets and compare them to well-established population estimates. Second, multiple extant studies of BPD rely and report results obtained with a categorical BPD diagnosis (Gunderson et al., 2000; Zanarini, Frankenburg, Hennen, Silk, 2003a). The ability to calculate an approximation of a BPD diagnosis allows researchers to either compare or replicate such studies, allowing for comparison and consistency across the BPD literature. Finally, a diagnostic cutoff can be used as a screening or a diagnostic tool in clinical practice settings where cutoffs are needed for screening, triage or billing purposes.

Overview of Current Investigation

I conducted two studies that further examined the validity of MBPD. Study 1 focused on a clinical sample of urban substance users in residential treatment. The goals of this study were as follows. First, I examined the convergent validity of MBPD by testing its relationship with well-established BPD measures. Second, I examined that the MBPD supported the nomological network of BPD by investigating its relationship with external correlates that have reliably been shown to be related to the construct of BPD. Previous work indicated that across different measures, BPD is related to the normal personality dimensions of trait-impulsivity, negative affect, and distress tolerance (Links et al., 1995; Whiteside & Lynam, 2001; Gratz, Tull, Baruch, Bornovalova, & Lejuez, 2008; Bornovalova, Lejuez, Daughters, Rosenthal, & Lynch, 2005), in addition to perceived stress (Bohus et al., 2000b) a reported history of childhood abuse (Herman, Perry, & van der Kolk, 1989; Links, Steiner, Offord, & Eppel, 1988; Ludolph et al., 1990; Ogata et al., 1990; Zanarini, Gunderson, Marino, Schwartz, & Frankenburg, 1989), and internalizing and externalizing psychopathology (Eaton et al., 2011; James & Taylor, 2008; Miller, Flory, Lynam & Leukefeld, 2003). If, in fact, the MBPD measured the latent BPD construct, then the MBPD should be related to these variables as well. Third, I examined if the MBPD carries incremental validity above and beyond the negative affect, a core component of BPD (Gratz, Tull, Baruch, Bornovalova, & Lejuez, 2008; Bornovalova, Matusiewicz, & Rojas, 2011; Trull et al., 2008) of BPD symptoms and these external correlates. Fourth, I examined the MBPD in terms of diagnostic accuracy for distinguishing between BPD versus non-BPD individuals. Finally, I aimed to establish diagnostic cutoff points that can be used in prevalence estimates, as well as clinical settings.

Study 2 focused on undergraduates followed longitudinally over a period of six months. As in Study 1, I examined the convergent validity, external correlates, and incremental utility of MBPD. Moreover, I examined the longitudinal stability of MBPD via three indices: mean-level change (or average change over time); rank-order stability (consistency over time in individuals' order within the population; test-retest reliability); and individual-level change (individual differences in change or stability over time; Baltes & Nesselroade, 1973). The use of these two diverse samples allowed me to investigate the validity of the MBPD across populations, in turn providing support for the generalizability of the measure. For detailed hypotheses please see Appendix A.

Study 1: Substance Users

Participants

Participants were 227 substance users at residential substance abuse facilities. Mean age of participants was 30.04 (SD = 8.40), and the sample was roughly equally split by gender (47% male, 53% female). Participants were 69.5% Caucasian, 13.5% African American, and 17% Hispanic. Regarding education, 22.4% had at least some college education, 17% completed high school or had a GED, and 20% did not complete high school. All participants completed a battery of questionnaires, and a clinical interview was verbally administered. In order to measure reliability, 25% of the audio-taped interviews were rated independently for symptom count and diagnosis by two raters who are trained research assistants. If there were discrepancies in symptom ratings and/or diagnosis, consensus was reached through the aid of a PhD level clinician (M.B.). Participants were compensated with $20 for completion of the assessment. All participants were provided written consent after written and oral assurances of confidentiality. The study was approved by the University of South Florida Institutional Review Board. As there was large overlap between Study 1 and Study 2 measures, and I aimed to increase the readability of the manuscript, Table 1 presents a summary of study measures and reliabilities, whereas Appendix A: Table A1, shows the schedule of assessments, and Appendix B shows a full, detailed description of the measures.

Convergent Validity

To establish the convergent validity of the MBPD, I examined its relationship with established BPD measures: the PAI-BOR and the SCID-II symptom counts of BPD. Pearson correlations were used to test the association between MBPD and the PAI-BOR and the SCID-II BPD symptom counts.
As seen in Table 2, the MBPD exhibited strong, positive, correlations with both the PAI-BOR (r = .70) and SCID-II BPD symptoms (r = .62).

External Correlates

In accordance with previous studies (Bornovalova et al., 2011; Verona, Hicks, & Patrick, 2005; Zanarini, 2000; Zanarini & Frankenburg, 1997; Zanarini et al., 1998) and the nomological network of BPD, I examined the relationship between MBPD and its external correlates. First, I examined Pearson correlations between the MPBD and normal personality dimensions (negative and positive affect, trait impulsivity, externalizing traits, distress tolerance), measures of perceived and actual stressors (perceived stress, childhood abuse), Axis II psychopathology (conduct disorder symptoms, adult antisocial behaviors), Axis I psychopathology (depression, anxiety, alcohol and substance use dependence symptoms) and self-report alcohol use and drug use. As expected, MBPD exhibited significant correlations (*ps*<.01) with negative affect, trait impulsivity, externalizing traits, distress tolerance, perceived stress, and childhood trauma (Table 2). In support of its discriminant validity and consistent with previous research (Rojas, et al., in press; Miller, Gentile, Wilson, Pryor, & Campbell, 2010), the MBPD did not show significant correlations with positive affect or sensation seeking. In terms of psychopathology, the MBPD exhibited the expected significant correlations with both Axis I and II psychopathology and self-reported drug and alcohol use (*rs* ranged from .18 - .45 *p* <.01), but failed to correlate with substance dependence and alcohol dependence.

Next, if the MPBD is indeed measuring the latent BPD construct, it should be correlated with the same external correlates as the PAI-BOR and SCID-II symptom count. And, the magnitude of its relationship with external correlates should be similar to the magnitude of the PAI-BOR and SCID-II symptoms with the external correlates. In order to investigate the latter, I performed Fisher R-Z transformations to test if the difference in the magnitude of the correlations were significant (p<.01). Results (Table 2) indicated that in almost all cases, the MBPD was related to the same external correlates as the PAI-BOR and the SCID-II symptoms. And, as seen in Table 2, in all cases, the magnitude of the relationship of MBPD with external correlates did not differ from the magnitude of the association of PAI-BOR and SCID-II with the same external correlates. However, it is important to note that the MBPD did exhibit a significant correlation with past-year substance whereas the PAI-BOR did not. Additionally, the MBPD exhibited a significant correlation with positive urgency while the SCID-II did not. Conversely, the

SCID-II exhibited additional significant correlations with alcohol and substance dependence, but the MPBD failed to do so.

Incremental Utility

In order to test that the MBPD predicts these external correlate above and beyond negative affect – a construct that frequently overlaps with BPD, I performed a series of linear regressions that included the predictors of age, sex, and negative affect in Step 1, and MBPD as an additional predictor in Step 2 predicting each external correlate individually. First and foremost, the MBPD significantly predicted BPD symptoms (B = .52, ΔR^2 = .22, p <.01) indicating that the MBPD accounted for significant variance in BPD symptoms above and beyond negative affect alone. As seen in Table 3, MBPD showed incremental utility for normal personality variables of two indices of trait-impulsivity and distress tolerance. Next, it showed incremental prediction of perceived stress and history of childhood abuse. Finally, for psychopathology, the MBPD significantly predicted all Axis II and I psychopathology symptoms but not substance use or alcohol use frequency.

Diagnostic Accuracy and Diagnostic Cutoff Points

Finally, I examined the sensitivity and specificity of MBPD in discriminating between BPD and non BPD individuals, and in doing so, I established diagnostic cut-off points as well. To do so, I performed a Receive Operator Curve (ROC) curve analysis to investigate the area captured under the curve by the MBPD. The ROC analysis plots the number of individuals classified as meeting BPD diagnosis on the SCID-II (true positive rate or sensitivity) on the ROC curve, by the number of individuals falsely classified as meeting BPD diagnosis (false positive rate or 1 – specificity). Out of 227 substance users, 115 were classified as meeting BPD diagnosis and 111 were classified as not meeting BPD diagnosis, with 1 missing case. A value of 0.50 indicates no discrimination or change, while a value of 1.0 indicates perfect discrimination between BPD individuals and on BPD individuals (Swets, 1996; Mcfall & Treat, 1999). Although there are no extant “hard” rules for establishing diagnostic cutoff points, the current practice is to set them at points which provide the maximum balance between sensitivity and specificity (van Erkel & Pattynama, 1998).

Results of the ROC analysis on the MBPD indicated an excellent level of discrimination for accurately distinguishing between BPD individuals and non BPD individuals, such that the area under the curve was .80 (95% CI: 0.74 – 0.86). As for the diagnostic cutoffs, there were two acceptable cutoff points (visual representation provided in Figure 1). At the cut-off score 10.77, the sensitivity was 70% and the specificity was 80%, resulting in type I error of 20%. This cut-off classified 70% people as true positive, 19% as false positive, 30.4% as false negative, and 80.7% as true negative. At a more liberal estimate, a cutoff score of 10.09, the sensitivity was 78% and the specificity was 72%. This results in a type I error rate of 28%. Additionally, this cut-off classified 78% as true positive, 28.4% as false positive, 22.3% as false negative, and 71.6% as true negative. Previous studies suggest including both a conservative cut score (definite diagnosis or having the required number of symptoms to meet the diagnostic cut-off) along with a more liberal diagnostic cut score (probable diagnosis or meeting one less symptom than the diagnostic cut-off). This method included individuals who may have difficulty with reporting symptoms (e.g. underreporting symptoms) due to reliance on memory (Kessler et al., 2003), and those who have subclinical diagnoses (not meeting the threshold of DSM-IV criteria) but still exhibit significant impairment (Pickles et al., 2001; Kessler et al., 2003). As a conservative cut-score (definite diagnosis) often provides an extreme estimate, resulting in underestimation of those meeting clinical diagnosis (Elkins, King, McGue, & Iacono, 2006*;* King, et al., 2009*)*, I included a more liberal cutscore in order to generate a more inclusive estimate. Thus, I created two diagnostic cutoffs: a probable cutoff (a score of 10) and a more conservative, cutoff (a score of 11). Notably, as scores on the MBPD are integers, integer cutoff values were used.

Table 1.

Assessment Measures

Variable	Instrument	Description	Received In:	Reliability
Target Measure	MBPD (Bornovalova, Hicks, Patrick, Iacono, & McGue, 2011)	Putative indicator of BPD traits	Study 1 and Study 2	αs = .76 - .77
Convergent				
Self-report	Personality Assessment Inventory (PAI-BOR; Morey, 1991)	Self-report continuous measure of BPD traits	Study 1 and Study 2	αs = .86 -.72
Diagnostic	SCID-II for BPD (Structured Clinical Interview for DSM-IV Axis II Disorders; First, Gibbon, Spitzer, Williams & Benjamin, 1997)	BPD symptom count from diagnostic interview	Study 1	κ = .74
External Correlates - Personality and Trauma History				
Negative and Positive Affect	Positive and Negative Affect (PANAS; Watson & Clark, 1988)	Self-report measure of state negative and positive affect		αs = .72 - .85
Trait Impulsivity	UPPS-P Impulsive Behavior Scale (UPPS-P; Lynam, Smith, Whiteside, & Cyders, 2006)	Negative urgency, (lack of) premeditation, perseverance, sensation-seeking, positive urgency, scales of UPPS	Study 1 and Study 2	αs = .82 - .90
EXT inventory	Externalizing Behaviors (EXT-159; Venables, Patrick, 2012).	Externalizing traits and behaviors		αs = .74 - .92
Distress Tolerance	Frustration Discomfort Scale (FDS Harrington, 2005)	Self-report measures of individual's tolerance of psychological distress	Study 1	α = .99
	Distress Tolerance Scale (Simons & Gaher, 2005)			
	Tolerance of Negative Affective States (TNASS - Bernstein and Brantz, 2012)			

Table 1 continued

Perceived Stress	Perceived Stress Scale (PSS – Cohen & Williamson, 1988)	Self-report of stress in daily life over the last month	Study 1 and Study 2	αs .86–.96 Factor loadings >|.5||
Childhood Abuse	Childhood Trauma Questionnaire (CTQ; Bernstein et al., 2003)	Childhood sexual, physical, emotional abuse		
External Correlates – Psychopathology				
CD	SCID-II for Antisocial Personality Disorder (Structured Clinical Interview for DSM-IV Axis II Disorders; First, Gibbon, Spitzer, Williams & Benjamin, 1997)	Symptom counts for conduct disorder	Study 1	κ =.96
AAB		Symptom count of adult antisocial behaviors		κ = .67
Depression	Mini International Neuropsychiatric Interview (M.I.N.I.; Sheehan, Janavs, Baker, & Harnett-Sheehan, 1999)	Symptom counts of lifetime and current major depressive disorder	Study 1 and Study 2	κs = .79 – 1.00
Anxiety		Composite of symptom counts for lifetime panic disorder, current post-traumatic stress disorder, current generalized anxiety disorder		κs .74-1.00
Alcohol Dependence		Symptom count for current alcohol dependence		κs = 1.00 -1.00
Substance Dependence		Maximum endorsed symptoms across amphetamines, cannabis, cocaine, hallucinogens, inhalants, opioids, PCP, and sedatives		κs = .96 -1.00
Alcohol Use	National College Health Risk Behavior Survey (NCHRBS; Center for Disease Control, 1997)	Past year alcohol use	Study 1 and Study 2	—[2]
Substance Use		Past year substance abuse		—[2]

Table 1 continued

Note: Diagnostic reliability was calculated using the kappa coefficient (κ), scale internal consistency was evaluated using Cronbach's alpha (α),composite measure was calculated utilizing a principals component analysis (PCA), the reliability of a composite measure composed of multiple measures was computed separately for each measure (Cronbach's alpha). The alpha could not be computed because of the small number of items (three or less). Study 1 refers to substance users; Study 2 refers to college students.

Table 2.

Substance Users Correlations between Convergent Validity Measures and External Correlates

	MBPD	PAI-BOR	BPD Symptoms	MBPD-PAI Contrast Z	MBPD-BPD Contrast Z
MBPD	----------	.70**	----------	----------	----------
PAI-BOR	----------	----------	.61**	1.51	----------
BPD Sx	.62**	----------	----------	----------	----------
PANAS-PA	-.03	-.01	-.07	-.29	.40
PANAS-NA	.40**	.49**	.37**	-1.16	.37
Positive Urgency	.27**	.34**	.16	-.82	1.07
Negative Urgency	.34**	.50**	.30**	-1.89	.49
Lack of Perseverance	.24*	.39**	.29**	-1.61	-.47
Lack of Premeditation	.20*	.41**	.24*	-2.26	-.37
Sensation Seeking	.00	.08	.02	-.77	-.14
EXT	.45**	.50**	.39**	.-.67	.76
Distress Tolerance	-.42**	-.51**	-.46**	1.13	.43
Childhood Abuse	.31**	.33**	.36**	-.22	-.54
Perceived Stress	.41**	.56**	.39**	-2.02	.25
Conduct Disorder Sx	.32**	.18**	.23**	1.50	1.01
Adult Antisocial Behavior Sx	.45**	.46**	.50**	-.12	-.68
Anxiety Sx	.56**	.52**	.60**	.65	-.63

Table 2 continued

Major Depressive Sx	.39**	.40**	.56**	-.05	-2.25
Alcohol Dependence Sx	.16	.17	.20*	-.05	-.44
Substance Dependence Sx	.13	.11	.30**	.22	-1.89
Past-year Alcohol Use	.21**	.24**	.17**	-.31	.40
Past-year Substance Use	.25**	.18	.20*	.76	.54

Note. *p<.01, **p<.001. MBPD-PAI/MBPD-BPD contrast Z indicate difference in magnitude between correlations between MBPD and external correlates compared to convergent validity measures and external correlates. Negative contrast z indicates that the correlations for the convergent validity measures (PAI-BOR/SCID-II BPD symptoms) are higher. Sx = symptoms

.

Table 3.

Predictive Utility of MBPD of External Correlates in Substance Users.

	Step 1					Step 2					
	Age	Sex	NA	Multiple R	R^2 Δ	Age	Sex	NA	MBPD	Multiple R	R^2 Δ
BPD Sx	.-.08**	-.26**	.32**	.45	.20**	.01	-.21**	.13	.52**	.65	.22**
Positive Urgency	-.10	.08	.12	.17	.03	-.05	.11	.02	.27*	.30	.06*
Negative Urgency	-.08	-.03	.19	.21	.04	-.03	-.01	.07	.30**	.34	.07**
Lack of Premeditation	-.11	-.25*	.19*	.35	.12**	-.09	-.24*	.16	.10	.36	.01
Lack of Perseverance	.00	-.11	.33**	.36	.13**	.02	-.10	.28**	.13	.38	.01
Sensation Seeking	-.17	.09	-.06	.22	.05*	.16	.10	-.07	.03	.22	.00
EXT inventory	-.15	06	.27**	.31	.10**	-.09	.11	.13	.40**	.47	.13**
Distress Tolerance	.08	.05	-.34**	.35	.12**	.03	.02	-.22*	-.33**	.47	.09**
Perceived Stress	-.18*	-.11	.44**	.50	.25**	-.14	-.09	.35**	.23*	.54	.04*
Childhood Abuse	.14	-.25**	.03	.31	.10**	.19*	-.23*	-.08	.29**	.41	.07**
Conduct Disorder Sx	-.20*	.18	.05	.29	.08*	-.14	.21*	-.08	.36**	.43	.11**

Table 3 continued

Adult Antisocial Behaviors	-.01	-.07	.19	.24	.06*	-.01	-.07	.04	.40**	.43	.13**
Major Depressive Disorder Sx	.05	-.24*	.29**	.42	.17**	.10	-.21*	.17	.30**	.50	.07**
Anxiety	.07	-.12	.45**	.49	.24**	.15	-.07	.27**	.46**	.64	.17**
Alcohol Dependence Sx	.04	-.03	.07	.09	.01	.07	-.01	-.01	.20	.20	.03
Substance Dependence Sx	.02	-.15	.15	.24	.06	.02	-.15	.14	.04	.24	.00
Past-Year Alcohol Use	.05	.05	.12	.13	.02	.08	.07	.04	.21	.22	.03
Past-Year Substance Use	-.18	-.05	.12	.22	.05	-.14	-.03	.04	.20	.28	.03

Note. * p<.01, **p<.001.Standardized regression weights are presented. Age, sex, and negative affect entered at Step 1, MBPD added at Step 2. Sx = symptoms

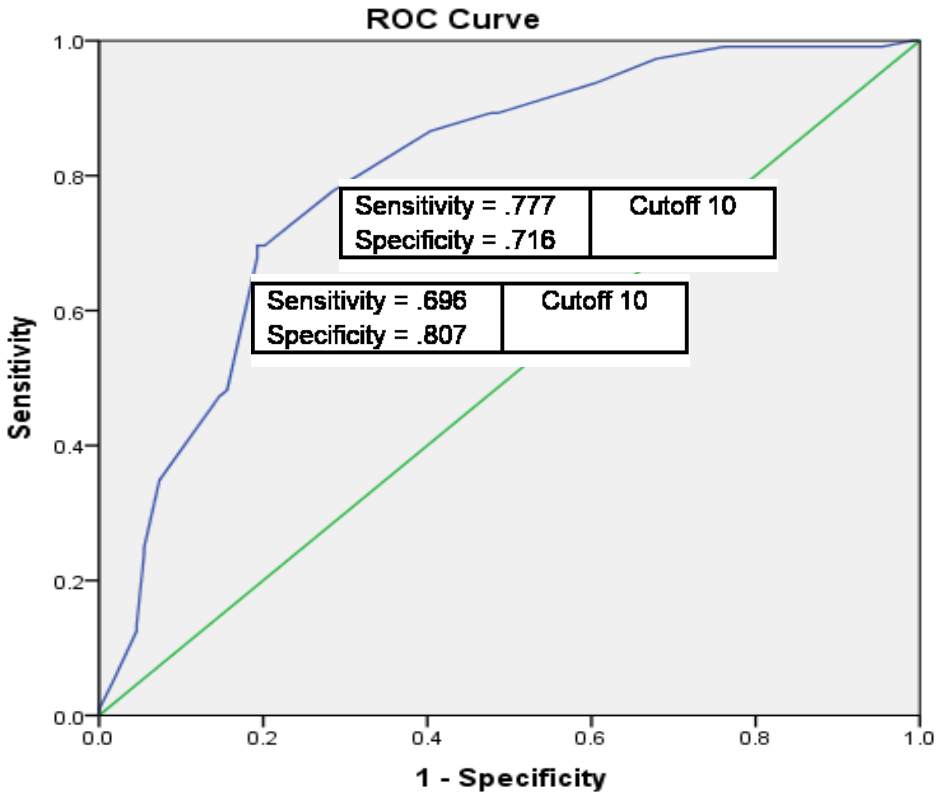

Figure 1. Substance Users ROC Curve

Study 2: Undergraduate Students

Participants

Participants were 348 University of South Florida undergraduates recruited from the SONA subject pool of Psychology students. Approximately half of these students (N = 233) were followed longitudinally across three time points, termed Assessment 1 (A1), A2 (M = 91.64 days later, SD = 64.85) and A3 (M =91.67 days after A2, SD = 61.22). Mean age was 20.47 (SD = 4.30) with 25% males, 75% females. The ethnicity breakdown was, 52% Caucasian, 16% African-American, 20% Hispanic/Latino, 11% Asian/Southeast Asian, and 1% Native American. The follow up rate was 88% at A2 and 79% at A3. All participants completed a battery of questionnaires, and a clinical interview was verbally administered. All procedures were identical at each assessment time point, and the clinical interview reliability procedure was identical to that used with the substance user sample. Participants received $20 for completion of each study visit. All participants were provided written consent after written and oral assurances of confidentiality. The study was approved by the University of South Florida Institutional Review Board. Table 1 presents a summary of study measures and reliabilities.

Convergent Validity and External Correlates

Similar to the results among substance users, MBPD exhibited strong, positive, correlations with the convergent validity measure, the PAI-BOR (Table 4).

Next, as seen in Table 4, the MBPD exhibited significant correlations with the normal personality dimensions of most indices of impulsivity, negative affect, and distress tolerance as well as with perceived stress but not history of childhood abuse. In contrast to the results with substance users, the MBPD was not significantly related to lack of premeditation or childhood abuse. In support of its discriminant validity, the MBPD did not correlate with sensation seeking or positive affect – a result consistent with the results among substance users and previous work (Rojas et al., 2013; Miller et al., 2010). With regards to psychopathology, the MBPD exhibited significant correlations with anxiety symptoms, MDD, and self-

report past year substance use (*rs* = .15 – 53, *p*<.01), with the exception of the relationship with past-year substance use, which was again similar to that of Study 1.

As in Study 1, I examined a) if MBPD is correlated with the same external correlates as the PAI-BOR, and b) if the magnitude of its relationship with external correlates is similar to the magnitude of the PAI-BOR external correlates. Results (Table 4) indicated that that in almost every case, the MBPD was related to the same external correlates as the PAI-BOR. And, comparisons of the magnitude of associations indicated no significant differences. It is important to note, that the PAI-BOR did exhibit an additional significant relationship with childhood abuse, while MBPD failed to exhibit this relationship. This indicated that the MBPD and PAI-BOR show virtually the same magnitude of relationship with external correlates.

Incremental Utility

Next, I examined if the MBPD predicts external correlates above and beyond negative emotionality. As in Study 1, for each external correlate, I fit two regression models, in Step 1, I entered age, sex, and negative affect, and in Step 2, I entered MBPD. Results (Table 5) indicated that, even after accounting for negative affect, MBPD significantly predicted indices of impulsivity, distress tolerance, perceived stress, and a history of childhood abuse. Next, MBPD predicted anxiety symptoms, and MDD symptoms, but neither alcohol nor substance use disorders or frequency of use. Overall, these results indicated that the MBPD is in fact predicting correlates of BPD above and beyond a construct that highly overlaps with BPD, supporting its incremental utility.

Rank-Order Stability

Next, I assessed rank-order stability, or the extent to which participants' MBPD scores remained stable, relative to that of their peers, by conducting a series of Pearson correlations between A1, A2, and A3. MBPD exhibited high rank-order stability across the three assessment points for the entire sample (A1 – A2: *r* = .67, *p*<.001*;* A2 – A3: *r* = .72 *p*<.001; A1 – A3: *r* = .72, *p*<.001). These results support that MBPD was relatively stable over time and indicated that individuals who are relatively high at A1 are also in the top ranges for A2 and A3.

Mean Level Change

Before proceeding to the longitudinal analyses, I noted that participants had considerable variability for number of days between assessments. The average number of days between A1 and A2 was 91.64 days (SD = 64.85, Range = 343 days), and between A2 and A3 was 91.67 days (SD = 61.22; Range = 377). Thus, I regressed the variability in time between A1 and A2 (the mean number of days between assessment and the squared term of mean number of days between assessments) from MBPD scores at A2, and the variability in time between A2 and A3 from MBPD scores at A3.

Mean-level change refers to the magnitude of change in the average scores over time for a given population. A repeated measures ANOVA with time as the within-level factor, and sex as the between-level factor was used to determine if there was mean-level change in MBPD over three assessment time points, and if change in MBPD scores differed by sex. In addition, univariate ANOVAs were run to identify any gender differences in mean-level MBPD scores at each assessment. Results (Figure 2) indicated that across assessments, there was a moderate and significant effect of time [$F(2) = 14.80$, $p < .001$, $d = .58$]. However, upon further investigation, these effects were found to be significant specifically between A1 and A2 [$F(1) = 16.34$, $p < .001$, $d = .57$], and A1 and A3 [$F(1) = 20.10$, $p < .001$, $d = .67$], such that there were large effects of time. When examining the magnitude of change between A2 and A3, there was no effect of time [$F(1) = .40$, $p = .529$, $d = .09$]. These results suggested that significant mean-level change occurred between A1 and A2. Further, there was no effect of sex overall [$F(1) = .01$, $p = .930$, $d = .00$] or at any specific time point (All Fs < .01; all ps = ns, all ds < .07). There was no gender by time interaction [$F(1) = 1.21$, $p = .272$, $d = .17$].

Individual Level Change

Finally, I investigated individual level change in MBPD scores over time using an individual growth curve modeling approach. This allowed me to account for the nestedness of the data such that assessments were nested within individuals. I fit several individual growth curve models using PROC MIXED in SAS with the Maximum Likelihood (ML) estimator that included both fixed and random effects. The fixed effects provide mean parameter values for the sample, and the random effects refer to the variability of the parameters estimates from the individual participants. Significant random effects indicate that there are interindividual (between individuals) differences in intradindividual (within individuals)

change over time. The first model, termed the 'Unconditional Growth Model', included a random effect of the intercept. This model allows us to estimate the intraclass correlation (ICC) accounting for between individual and within individual variance (Raudenbush & Bryk, 2002). The second model termed 'Linear Growth Model' included time as a fixed and random effect. I compared model fit utilizing the 2 x Log Likelihood (-2LL) ratio test to choose the more parsimonious model. The third model termed 'Quadratic Growth Model' included fixed effects of the squared term of time and sex as additional predictors of change over time. The quadratic term was included as a fixed effect only, because due to the small degrees of freedom, estimating the variance of all parameters (intercept, slope, quadratic) may result in finding significant results simply due to chance, thus increasing the Type I error.

Please refer to Table 6 for model fit estimates. The unconditional growth model showed that the ICC = .65, indicating that 65% of the total variance in MBPD scores were accounted for by between individual variance, however the remaining 35% was within individual variance. Therefore, it was appropriate to use a multilevel modeling approach to estimate this within individual variance. First, I compared change in model fit from the baseline model to the linear growth model using the -2LL likelihood ratio test, $\Delta\chi 2\ (3) = 23.90$, $p < .001$ and chose the latter as it showed significantly better fit. Results for the linear growth model showed that on average (β_{00}) individuals scores were 7.41 at A1 or baseline. In addition, there was considerable variance around the intercept, $\tau_{00} = 10.91$, meaning that at baseline some individuals had higher scores while others had lower scores such that roughly 95% of score fell between .80 – 14.01. Further, on average, individuals' scores decreased by .0049 per day (β_{10}), thus over 90 days scores decreased by .44 at A2, and over 180 days, scores decreased by .88 at A3. These results indicated a small effect of time on the negative slope or growth rate of individuals [$t(384) = -4.03$, $d = -.41$, $p<.001$]. Moreover, there was a modest amount of variance in this growth rate (slope) τ_{11}= .000069, suggesting that some individuals MBPD scores change at a faster rate than others, where 95% of the range in growth rates fell between .02 -.02. Finally, negative covariance of the intercept and slope suggested that those with higher scores change at a slower rate, $z = -2.27$, $p < .05$. The final model, the quadratic growth model, with sex as an additional predictor showed significantly better fit than the linear growth model using the -2LL likelihood ratio test, $\Delta\chi 2\ (1) = 9.20$, $p < .01$, supporting that the addition of the quadratic term improved model fit. Therefore, the effect of the quadratic term served to bend the

curve of the linear trend, indicating that the rate of decline in MBPD scores starts to decrease over time, $\beta_{20} = .00003$, supporting quadratic or nonlinear change over time. However, the addition of sex as a predictor was not significant. Thus these results indicated that there was a significant effect of time on change in individual's scores, and that there was significant variability in this change at the individual level. Additionally, on average, there was a small yet significant decrease in the rate of decline of change in MBPD scores over time. Taken together these results suggested there were relatively small interindividual differences in intraindividual change in scores over time.

Table 4.

Undergraduate Students Correlations between Convergent Validity Measures and External Correlates

	MBPD	PAI	MBPD-PAI Contrast Z
MBPD	----------	.73**	----------
PAI-BOR	----------	----------	----------
PANAS-PA	-.12	-.20**	.85
PANAS-NA	.29**	.34**	-.51
Positive Urgency	.35**	.35**	.03
Negative Urgency	.53**	.63**	-1.43
Lack of Perseverance	.24**	.39**	-1.64
Lack of Premeditation	.11	.16	-.54
Sensation Seeking	.10	-.06	1.57
Distress Tolerance	-.41**	-.47**	.39
Perceived Stress	.52**	.61**	-1.40
Childhood Abuse	.17	.29**	-1.29
Anxiety Sx	.33**	.43**	-1.55
Major Depressive Sx	.40**	.46**	-1.09
Alcohol Dependence Sx	.07	.10	-.41
Substance Dependence Sx	.09	.11	-.32
Past-year Alcohol Use	-.01	.04	-.61
Past-year Substance Use	.15*	.17*	-.34

*Note**p<.01, **p<.001. MBPD = Minnesota Borderline Personality Disorder Scale and PAI-BOR = Personality Assessment Inventory – Borderline Scale. MBPD-PAI indicate differences in magnitude between correlations between MBPD and external correlates compared to PAI-BOR with external correlates. Negative signs for "Measure Difference Contrast Z" indicate that the correlation between PAI-BOR and external correlates is higher. Sx = Symptoms

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Table 5.

Predictive Utility of the MBPD in Undergraduate Students

	Step 1					Step 2					
	Age	Sex	NA	Multiple R	R^2 Δ	Age	Sex	NA	MBPD	Multiple R	R^2 Δ
Positive Urgency	-.07	.25**	.27**	.35	.12**	-.02	.25**	.18*	.30**	.45	.08**
Negative Urgency	-.05	.05	.26**	.26	.07*	.02	.04	.11	.51**	.55**	.23*
Lack of Premeditation	-.05	.06	.07	.10	.01	-.04	.06	.05	.09	.13	.01
Lack of Perseverance	-.02	.07	.26**	.26	.07*	.01	.06	.21*	.18	.31	.03
Sensation Seeking	-.08	.28**	.02	.29	.08*	-.07	.27**	-.01	.10	.30	.01
Distress Tolerance	-.01	.16	-.31**	.37	.14**	-.06	.16*	-.21*	-.35**	.49	.11**
Perceived Stress	-.08	-.13	.42**	.46	.21**	-.02	-.14	.31**	.39**	.59	.13**
Childhood Abuse	.20*	.03	.04	.20	.04	.23*	.02	-.03	.22*	.28	.04*
Major Depressive Disorder	.19*	-.02	.22*	.29	.08*	.23**	-.03	.13	.34**	.43	.10**
Anxiety Symptoms	.20*	-.13	.32**	.41	.17**	.24**	-.14	.24**	.28**	.49	.07**
Alcohol Dependence	.03	.23*	.06	.23	.05	.04	.23*	.04	.08	.24	.01
Drug Dependence	-.04	.07	.01	.08	.01	-.03	.07	-.01	.09	.12	.01
Past-year Alcohol Use	.21*	.18	.03	.27	.07*	.22*	.18	-.01	.10	.28	.01
Past-year Drug Use	-.06	.21*	.01	.22	.05	-.04	.20*	-.03	.16	.26	.02

Note. * p<.01, **p<.001.Standardized regression weights are presented. Age, sex, and negative affect entered at Step 1, MBPD added at Step 2. Sx = symptoms

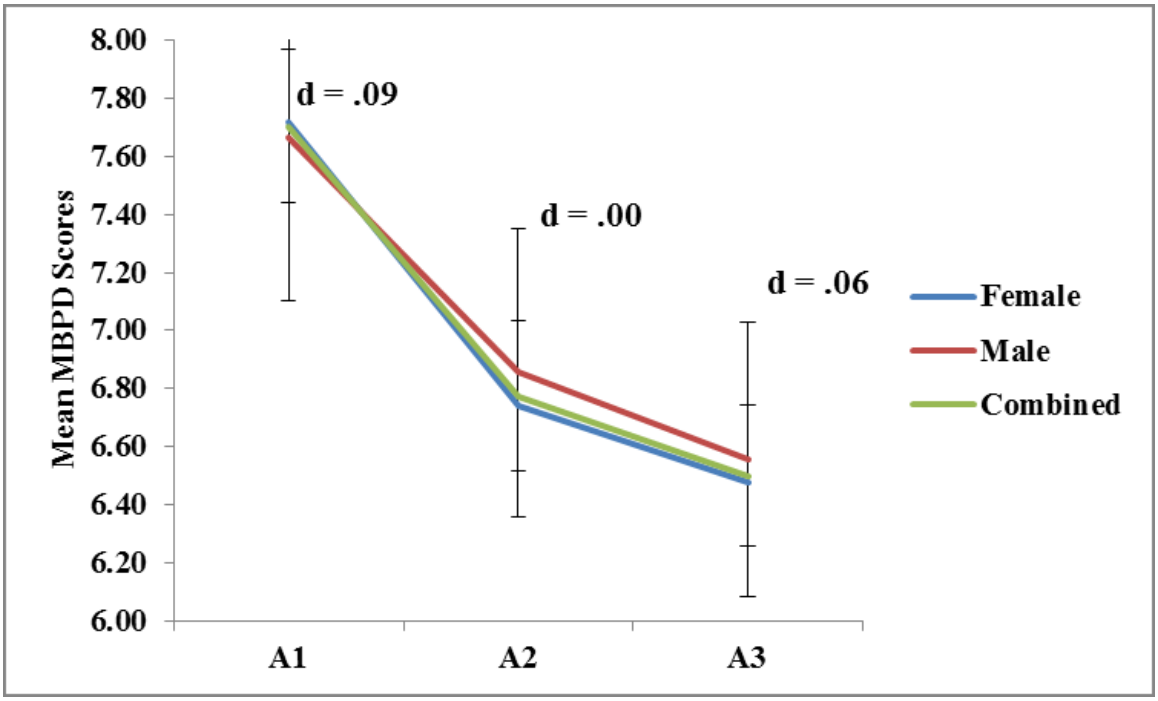

Figure 2. Mean Level Change. Effect sizes (Cohen's d) above each assessment time point test for gender differences and significance levels for these differences at each assessment. There were no gender differences at any time point.

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Table 6.

Individual Growth Curve Model Estimates

	Unconditional Growth	Linear Growth	Quadratic Growth by Sex
Fixed Effects			
Intercept β_{00} (SE)	7.05 (.22)*** *t*(231) = 31.90***	7.41 (.25)*** *t*(231) = 30.00***	7.53 (.28) *t*(230) = 26.43***
Slope β_{10} (SE)		-.0049 (.0012) *t*(384) = -4.03***	-.012 (.002) *t*(383) = -4.52***
Sex B_{30} (SE)			.13 (.49) *t*(230) = .27
Acceleration Rate β_{20} (SE)			.00003 (.00001) *t*(383) = 3.05**
Random Effects			
Variance of intercept τ_{00} (SE)	9.29 (1.07)***	10.91(1.36)***	10.90 (1.35)***
Variance of slope τ_{11} (SE)		.000069 (.000031)*	.000061(.000030)*
Covariance of intercept and slope τ_{10} (SE)		-.01 (.01)*	-.01 (.01)*
Residual Variance σ (SE)	4.97 (.36)***	4.14 (.37)***	4.08 (.36)***
-2LL	3148.10	3124.20	3115.00
df	3	6	8

*p<.05, **p<.01, ***p<.001. The unconditional growth model included a random intercept only. The linear growth model included a random intercept and slope of time. The quadratic growth model included a fixed effect of time squared and an additional predictor of sex. Some parameter estimates are carried out further than two decimal places to indicate actual value. -2LL = -2 Log Likelihood. df= degrees of freedom.

Discussion

I conducted two studies that aimed to further validate the MBPD. Overall the general expectations regarding the construct validity of the MBPD were supported. Across both samples, the MBPD showed strong, significant correlations with gold standard measures of BPD (self-report measure PAI-BOR and diagnostic measure SCID-II BPD). Next, across both samples, the MBPD showed correlations with normal personality dimensions, perceived stress, trauma, and Axis II and I psychopathology that have been shown to be related to the BPD construct in previous studies and are part of the construct's nomological network (Goldman, Dangelo, & Demaso, 1993; Trull et al., 2001; Zanarini, Frankenburg, Hennen, & Silk, 2003). These results support that in fact the MBPD is behaving as the latent construct of BPD is expected to act. Third, in both studies, the MBPD was related to the same external correlates as the PAI-BOR and the diagnostic BPD symptom count. Further, the magnitude of the relationships between the MBPD and external correlates were similar to the relationships between the gold standard measures and external correlates, showing that the MBPD is behaving much like the gold standard measures. However, there were a few external correlates that the MBPD did not exhibit significant correlations with but the other convergent validity measures did, and this could be due to measurement variance or results found by chance. For example, alcohol dependence was related to SCID-II BPD symptoms but not the PAI-BOR or MBPD, suggesting that it could be the nature of the measure rather than actual differences in relationships between these measures and external correlates. Both these measures were diagnostic, clinician administered interviews (SCID-II BPD, SCID-I for Alcohol Dependence) while the PAI-BOR was a self-report continuous measure. Further due to the multiple amount of tests performed, some differences may be due to Type I error or chance. Fourth, the MBPD significantly predicted several external correlates above and beyond negative affect, indicating once again that MBPD is not just measuring affective distress. Moreover, these results were similar across samples. Taken together, these results provide further support for the validity of the MBPD in both clinical and non-clinical samples.

Beyond the usual construct validity indices, I have made three additional contributions regarding the validity of this measure. First, I provided novel evidence that the MBPD displays excellent discrimination in terms of identifying between BPD and non BPD individuals, as illustrated by the ROC analyses. A previous study reported that that the PAI-BOR exhibits a reasonable or good level of discrimination for accurately distinguishing between BPD individuals versus non-BPD individuals (Distel, Hottenga, Trull, & Bornovalova, 2008), and the data indicate that the MBPD is performing as well as the PAI-BOR. Next, I established “probable” and “definite” cutoff scores on the MBPD for the use in research and clinical settings. As I noted in the introduction, cutoff scores allow for comparison of prevalence rates to large epidemiological or clinical studies; comparison of results obtained with the MBPD to studies that use the traditional diagnostic cutoff; and allows for screening, triage or billing purposes in clinical settings.

This study utilized one statistical approach to produce cut-scores; however it is important that future studies validate these cut scores using other methodical approaches in multiple samples. For example, one approach would be exploring Item Response Theory (IRT) based methods for choosing cut scores (see Emons, Sjitsma, & Meijer, 2007; Hendrawan, Glas, & Meijer 2005) including those that take into account the multidimensionality of a measure (see Reckase, 1997). Thus this could provide further evidence that in fact the cut scores presented here show the same discriminatory ability in other samples.

Finally, I examined the short-term longitudinal stability and change of the MBPD. MBPD exhibited high test-retest reliability or rank-order stability, indicating that individuals who scored the highest relative to their peers on the MBPD at baseline, will remain near the top six months later. Another study that looked at test-retest reliability of the PAI-BOR over the same time period, indicated similar rank order stability (Trull et al., 1995). However, on a mean-level, the MBPD exhibited significant change over time, showing moderate effects of time specifically between A1 and A2. Finally, there was small but significant individual-level change meaning that individuals are changing at different rates, and thus average change over time does not represent the entire sample. Moreover, this individual rate of change is not linear such that rate of decline in scores slows over time. This individual level variability supported the construct validity of this measure across time as evidenced by prior researchers. Previous research suggests that BPD traits fluctuate over time (Schmideberg, 1959, Hopwood et al., 2009; Morey & Hopwood, 2012), and that these individuals demonstrate similar intraindividual change as shown in the current study (Hopwood,

Thomas, Markon, Wright, & Krueger, 2012). Overall, it appears that, across studies, the MBPD is accurately measuring the latent construct of BPD.

There are several strengths to this study. First, I investigated the construct validity of the MBPD in two fairly large samples, including clinical and non –clinical samples. Second, the samples were fairly diverse and representative of the general ethnic break-down of the population. Third, one of the samples was followed longitudinally, allowing for examination of test-retest reliability (also rank-order stability). However, several limitations for this study should be noted. First, there was a gender imbalance among the undergraduate students, such that there were nearly four times as many females in comparison to males. It is possible that this imbalance may have skewed the results more in the direction of the females. Although gender differences were not the main focus of this paper, it is important that future research replicate the current work while balancing the gender breakdown, specifically in a non-clinical sample. Secondly, the undergraduate sample lacked an additional diagnostic measure of convergent validity which would have added to the construct validity and diagnostic ability of the MBPD in a non-clinical sample.

In general, further validation of a short, self-report measure of BPD traits has several advantages. For example, archival data sets, or other longitudinal, epidemiological samples that include other psychopathology and personality measures like the Multidimensional Personality Questionnaire, but no direct assessment of BPD traits would benefit from this measure, as it would allow these researchers to easily derive the MBPD from the MPQ (e.g., Dunedin Multidisciplinary Health Development Study, Caspi, et al., 1997; Iowa Youth and Families Project, Iowa Single Parent Project; Donnellan, Assad, Robins, & Conger, 2007; Donnellan, Conger, & Burzette, 2007; Ge & Conger, 1999; Kim, Conger, Lorenz, & Elder, 2001; the Minnesota Study of Twin Reared Apart, Bouchard, Lykken, McGue, Segal, & Tellegen, 1990; and the Minnesota Twin and Family Study, Iacono, Carlson, Taylor, Elkins, & McGue, 1999).

These and other datasets that include the MPQ can then provide information about BPD that was previously unavailable. For instance, the calculation of BPD features in these datasets will allow us to understand the etiological principals, underlying vulnerabilities, longitudinal course, and psychophysiology of the disorder. In turn, this may lead to a better understanding of prevention, and treatment of this form of psychopathology.

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Appendices

Appendix A. Hypotheses

1. Convergent validity: MBPD scores would show strong, positive correlations with both the BPD diagnostic measure and self-report measure of BPD.
2. External correlates:
    a. In accordance with previously established correlates of BPD, the MBPD would demonstrate a significant, moderate, positive correlation with external correlates such as childhood trauma, Axis I Psychopathology (e.g. Post Traumatic Stress Disorder, PTSD), distress tolerance, impulsivity, and risky behaviors (e.g. substance use, alcohol use), and antisocial, or externalizing behaviors.
    b. In addition, the MBPD should wield predictive, incremental utility of these external correlates, such that it uniquely predicts these correlates above and beyond negative affect, a core component of BPD, and therefore a construct that frequently overlaps with BPD (Bornovalova et al., 2011a; Bornovalova, Matusiewicz, & Rojas, 2011b; Gratz, Tull, Baruch, Bornovalova, & Lejuez, 2008;; Trull, Solhan,Tragesser, et al., 2008;; Selby, Anestis, Bender, 2009; Glenn & Klonsky, 2009) .
3. Test-retest reliability/Rank Order Stability. The MBPD would exhibit longitudinal stability at three time points, such that the correlation between administrations at baseline, 7 weeks, and 14 weeks should be strong, positive correlations.
4. Diagnostic Accuracy:
    a. The MBPD will yield good discriminant ability for distinguishing between BPD and non BPD individuals. This ability will be the similar to the discriminatory ability of the PAI-BOR for distinguishing between BPD and non-BPD individuals (Bell-Pringle, Pate, & Brown, 1997; Kurtz & Morey, 2001; Morey, 1991, 1996)
5. Mean Level Change/Individual Level Change:

Appendix A. Continued

a. Given the mixed literature surrounding the stability of BPD traits over time, I did not have hypotheses regarding the how these traits function over time. Studies suggest that BPD traits decline over time, especially during young adulthood, e.g. ages 17 - 24 (Bornovalova et al, 2009); similarly, a study of the short-term diagnostic stability of BPD showed that over 6 months, there was a significant decline in number of criteria met (Shea et al., 2002). However other studies suggest that BPD is a chronic personality disorder (e.g. DSM-IV for BPD), and should be consistent over time. Hence, I had no strict hypotheses regarding the stability or change in BPD traits over time.

Appendix B. Schedule of Assessments

Table B1.

Schedule of Assessments

	Sample			Follow-Up (A2)	Follow-Up (A3)	N
Undergraduates		**Construct**	**Extern. & Incr.**	**Construct**		
	Subsample 1	MBPD PAI-BOR	MINI for Axis I disorders, Distress Tolerance Measures, NCHRBS, UPPS, Perceived Stress, CTQ			**233**
	Subsample 2	MBPD PAI-BOR	MINI for Axis I Disorders, Self-report Distress Tolerance Measures, NCHRBS, UPPS, Perceived Stress, PANAS	MBPD PAI-BOR	MBPD PAI-BOR	**115**
Substance Users		MBPD PAI-BOR SCID II:BPD	SCID II:ASPD PANAS CTQ, MINI for Axis I Disorders, Self-report Distress Tolerance Measures, NCHRBS, Perceived Stress, Externalizing-159			**227**

Appendix C. Full Description of Measures

Target measure for validation

Minnesota Borderline Personality Disorder Scale (**MBPD; Bornovalova, Hicks, Patrick, Iacono, & McGue, 2011)**. The MBPD is a 19-item scale developed using items from the Multidimensional Personality Questionnaire (MPQ; Tellegen, 1982), a well-validated omnibus measure of normal personality. Previous work indicates that dimensional measures of BPD such as the Personality Assessment Inventory-Borderline scale (PAI-BOR; Morey, 1991), the Inventory for Interpersonal Problems-BPD scale (IIP-BPD; Lejuez et al., 2003; Pilkonis, Yookung, Proietti, & Barkham, 1996), and DSM-IV based BPD diagnostic interviews strongly correlated with the MBPD (*r*'s = .80-.89 with PAI-BOR and estimated PAI-BOR; *r*'s = .60-.66 with DSM-IV diagnostics; *r*'s = .60 with IIP-BPD) across normative and clinical samples (Bornovalova et al., 2011; Bornovalova et al., 2012; Rojas et al., *in press*). Additionally, in a sample of young female twins, MBPD scores demonstrated similar heritability as estimated PAI-BOR scores and a DSM-IV interview based diagnostic screener (Rojas et al., *in press*). Finally, consistent with the nomological network that of BPD, MBPD scores exhibited medium to large correlations with known BPD correlates including negative affect, impulsivity, antisocial behaviors, interpersonal problems, eating disorders, anxiety disorders, major depressive disorder, and alcohol and drug use (Bornovalova et al., 2011; Bornovalova et al., 2012; Rojas et al., *in press*). In both samples, internal consistency, Cronbach's α (alpha) was good; substance users (α = .77) and undergraduate students (Cronbach's α = .76, α =.74, α = .70 for all three assessments respectively) .

Measures of convergent validity

In both studies (substance users and undergraduate students) the continuous, self-report index of BPD was the Personality Assessment Inventory Borderline Features Scale (PAI-BOR; Morey, 1991). The PAI-BOR assesses severe personality pathology that is related to BPD and personality disorders. It consists of 24 items that are rated on a 4-point scale, and the possible total ranges from (0 –3; false, slightly true, mainly true, very true).

Appendix C. Continued

This scale taps four empirically derived dimensions for borderline phenomenology: affective instability, identity problems, negative relationships, and self-harm (Grinker, Werble, & Drye, 1968; Morey, 1988). Multigroup confirmatory factor analysis showed that the PAI-BOR is measurement invariant across sex and age (De Moor, et al., 2009). The PAI-BOR has good internal consistency (α = .84; Bornovalova, et al., 2011; Morey, 1991), high test-retest reliability over a 3-4 week time period (r = .86, Morey, 1991 (Morey, 1991) and good convergent and discriminant validity (Stein, et al., 2007; Trull, 1995). Reliability in the current samples was as follows. In both samples; substance users and undergraduate students, Cronbach's α = .86 and α= .72 respectively.

Only study 1 (substance users) received the diagnostic measure of BPD. Specifically, the diagnostic measure was the Structured Clinical Interview for DSM-IV Axis II Disorders (SCID-II) to determine BPD diagnosis as well as symptom count (First, Gibbon, Spitzer, Williams, & Benjamin, 1997). The interviews were given prior to administration of the self-report measures so there is no prior knowledge of scores on other self-report measures on the part of the interviewer. Interviews were conducted by trained graduate students or trained research assistants. In order to measure reliability, 25% of the audio-taped interviews were independently for symptom count and diagnosis by a rater who is a trained research assistant. If there was discrepancy in symptom ratings and/or diagnosis, consensus was reached through the aid of a PhD level clinician (M.B). The SCID-II has been shown both high reliability and validity (Spitzer, Williams, Gibbon, & First, 1989). Inter-rater reliability was κ = .74.

Measures of external correlates

Perceived Stress Scale (PSS – Cohen & Williamson, 1988). Both studies (substance users and undergraduate students) received the PSS, a 10-item scale taken from the original 14-item scale (Cohen, Kamarck, and Mermelstein, 1983). This scale is aimed at measuring self-report of stress in daily life over the last month. Items appear on a 4-point scale (0 = Never, 4 = Very often). Items include "In the last month, how often have you been upset because of something that happened unexpectedly."

Appendix C. Continued

This measure has demonstrated good validity (Cohen & Williamson, 1988; Cohen & Williamson, 1991) and short-term reliability (e.g. 4 – 8 weeks; Cohen, Kamarck, and Mermelstein, 1983). In both samples, substance users and undergraduate students, Cronbach's α = 72 and α = .85 respectively.

Positive and Negative Affect Scale (PANAS; Watson & Clark, 1988). Both studies (substance users and undergraduate students) completed the Positive and Negative Affect Schedule (PANAS). The PANAS assesses affective experiences over the past month, specifically positive feelings α = .84 (i.e. Enthusiastic) and negative feelings α = .84 (scared). Participants are asked to rate the extent to which they experienced each particular emotion on a five-point scale (1 = very slightly – 5 = very much) for 20 items. This measure has been accurately discriminates between negative and positive affect (Watson 1998; Chen, Dai, Spector, Jex, 1997; Joiner & Blalock, 1995) such that each scale (negative, positive) is considered an independent construct and exhibits high test-retest reliability (Crawford & Henry, 2004). In Study 1 (substance users) for the total scale, positive affect, and negative affect, Cronbach's α =.85, .90, .90 respectively. In Study 2 (undergraduate students) for the total scale, positive affect, and negative affect, Cronbach's α = .82, .88, .83 respectively.

UPPS-P Impulsive Behavior Scale (UPPS-P; Lynam et al., 2006). Both studies (substance users and undergraduate students) received the UPPS-P, a 59-item inventory that measures five subscales of impulsive behavior. The five subscales include Negative Urgency (i.e., "I have trouble controlling my impulses"), Positive Urgency (i.e., "When I am very happy, I can't seem to stop myself from doing things that can have bad consequences.") (lack of) Premeditation (i.e., "I have a reserved an cautious attitude towards life"), (lack of) Perseverance (i.e., "I tend to give up easily"), and Sensation-Seeking (i.e., "I'll try anything once). The subscales have 11, 13, 12, 10, and 14 items respectively, each of which are calculated by taking the mean of the items. The items have a 4-point Likert scale (1-strongly agree to 4-strongly disagree). This measure has demonstrated external validity with antisocial personality traits, pathological gambling, and borderline personality features (Whiteside, Lynam, Miller, & Reynolds, 2005). In substance users: Negative Urgency: α = .80; (lack of) Premeditation: α = .83; (lack of) Perseverance: α = .74; Sensation-Seeking: α =.84; Positive Urgency: α = .91, total scale: α = .92.

Appendix C. Continued

In undergraduate students: Negative Urgency: α = .86; (lack of) Premeditation: α = .86; (lack of) Perseverance: α = .80; Sensation-Seeking: α =.86; Positive Urgency: α = .92, total scale: α = .90.

Externalizing Behaviors. EXT-159 (Venables & Patrick, 2012). Study 2 (substance users) received the EXT -159, a self-report measure of externalizing behaviors and traits. This measure is adapted from the 415-item version and 100-item version of the Externalizing Spectrum Inventory (ESI, Bernat, et al., 2011; Nelson, et al., 2011; Hall, Bernat & Patrick, 2007; Blonigen et al., 2011) and has been shown to represent all 23 subscales of the ESI. Items appear on a 4-point scale (1 = True, 4 = False). The scale has four subscales: disinhibition (DIS), callous-aggression (AGG), and substance abuse (SUB). Item examples for each of the three subscales include, "I get in trouble for not considering the consequences of my action (DIS);" "I've told lies about someone just to see how it would affect them (AGG)," "I've smoked marijuana at a party (SUB)." The EXT-159 has demonstrated good validity in previous study (Venable & Patrick, 2012). In substance users, total score was used, Cronbach's α = .99.

Distress Tolerance. In both studies substance users and undergraduate students, received self-report measures of distress tolerance at A1. For purposes of data reduction, I performed a principal components analysis and calculated a regression score for three self-report measure (loadings were >|.5|) in order to create a distress tolerance factor.

Frustration Discomfort Scale (FDS; Harrington, 2005b). Both studies (substance users and undergraduate students) received self-report questionnaires of an individual's tolerance to distress. It consists of 35 items, with four 7-item subscales: discomfort intolerance, entitlement, emotional intolerance, and achievement. Apart from two items, all statements were worded only in terms of frustration intolerance. Individuals were asked to rate the strength of belief on a 5-point Likert-type scale (1 – absent; 5 – very strong). This measure has demonstrated both good internal consistency (α ≥ .84; Harrington, 2005b; Harrington, 2005a) and discriminant validity. Internal consistency of this measure is high in previous studies (α ≥ .84; Harrington, 2005b). In both samples, substance users and undergraduate students, Cronbach's α = .94 and .92 respectively.

Appendix C. Continued

Distress Tolerance Scale- DTS (Simons & Gaher, 2005). Both studies (substance users and undergraduate students) received the self-report questionnaire of an individual's tolerance to stress. It consists of 16 items reflecting four subscales: ability to tolerate emotional distress, appraisal of distress, absorbed by negative emotion, and regulation efforts to alleviate distress. Items are rated on a 5-point scale (1 – Strongly agree; 5 – Strongly disagree). Example items include, "I can't handle feeling distressed or upset". This measure has demonstrated both good reliability and validity (reliability: r = .61; internal consistency: α = .80; Simons & Gaher, 2005). Previous studies have shown that these measure correlate with BPD, such that BPD individuals evidence lower tolerance to stress in comparison to normal population (Chapman, Gratz, & Brown, 2006; Gratz, Rosenthal, Tull, Lejuez, & Gunderson, 2006). This self-report measure has been shown to be reliable and valid measures of an individual's tolerance to stress (Simons & Gaher, 2005). In both samples, substance users and undergraduate students, Cronbach's α = .89 and .86 respectively.

Tolerance of Negative Affective States Scale – (TNASS - Bernstein and Brantz, 2012). Both studies (substance users and undergraduate students) received this 25-item self-report questionnaire examining an individual's tolerance of negative emotions. Participants were asked to rate mood items, (e.g. "sad" or "angry") and how tolerant they are of these emotions (1 = intolerant, 5 = very tolerant). Tolerance and intolerance are defined in the measure's completion directions. This measure has shown good internal consistency α = .92 and has been related to other measures of distress tolerance while discriminating from other measures of pure negative affect (Bernstein & Brantz, 2012). In both samples, substance users and undergraduate students, Cronbach's α = .96 and .93 respectively.

Childhood abuse. Both studies (substance users and undergraduate student) received this self-report measure that assesses experiences with childhood abuse, the Childhood Trauma Questionnaire-Short Form (CTQ-SF; Bernstein et al., 2003). The CTQ-SF is a 28-item measure that assesses childhood maltreatment experiences (i.e., "while you were growing up") using a five-point scale ranging from 1 (never true) to 5 (very often true) across physical, sexual, and emotional abuse, and physical and emotional neglect.

Appendix C. Continued

Sample items include: “Someone tried to touch me in a sexual way, or tried to make me touch them,” “People in my family hit me so hard that it left me with bruises or marks,” and “People in my family called me things like ‘stupid,’ ‘lazy,’ or ‘ugly.’” The CTQ-SF has good sensitivity (.78 –.86) and satisfactory specificity (.61–.76) when self-reports are compared with trauma ratings from child welfare records and reports of family members and clinicians (Bernstein, et al., 2003). Similarly, among a sample of adult substance abusers, the CTQ demonstrated good test-retest reliability over a period of greater than 1 month ($r = .86$, $p < .01$; see Bernstein & Fink, 1998). In the current studies I utilized the subscale of abuse (sexual, physical, and emotional abuse. In both samples, substance users and undergraduate students, Cronbach’s $\alpha = .89$ and .91, respectively for the subscale of abuse.

Antisocial Personality Disorder. Study 1 (substance users) received diagnostic interviews for conduct disorder and adult antisocial behavior based on the Structured Clinical Interview for DSM-IV Axis II Disorders (SCID-II ASPD) to determine both symptom count and diagnosis for both (First, et al., 1997). In order to measure reliability, 25% of the audio taped interviews will be rated independently for symptom count and diagnosis by two raters who will be trained research assistants. If there were discrepancies in symptom ratings and/or diagnosis, consensus will be reached with the aid of a PhD level psychologist (M.B). This measure has been shown both high reliability and validity (Spitzer, Williams, Gibbon, & First, 1990). In Sample 1 (substance users) inter-rater reliability was CD ($\kappa = .96$) and for AAB ($\kappa = .67$).

Axis I Psychopathology. Both studies (substance users and undergraduate students) received the Mini-International Neuropsychiatric Interview (M.I.N.I.; Sheehan et al., 1999), a short structured diagnostic interview for DSM-IV and ICD-10 disorders, including Major Depressive Disorder (MDD), Generalized Anxiety Disorder (GAD), Post-Traumatic Stress Disorder (PTSD), and Alcohol and Substance Abuse/Dependence and Panic Disorder (PD). Symptom counts were assessed. In order to measure reliability, 25% of the audio-taped interviews were rated independently for symptom count and diagnosis by two raters who are trained research assistants. If there were discrepancies in symptom ratings and/or diagnosis, consensus was through the aid of a PhD level clinician (M.B.). Kappas were as follows for each individual diagnosis.

Appendix C. Continued

For undergraduate students: MDD (current κ = .84, lifetime κ = .79), PTSD (κ = 1.00), PD (κ = 1.00), GAD(κ = .74), alcohol dependence (1.00), substance dependencies (κ = 1.00). For substance users: MDD (current κ = .94; lifetime κ = 1.00), PD (κ = .95), PTSD (κ = 1.00), GAD (κ = .93), AD (κ =1.00), substances dependencies (κs range from .96 – 1.00). This interview has shown concordance with the Structure Clinical Interview for Axis I DSM-IV Disorders (SCID-I; Sheehan, Lecrubier, & Sheehan, 1998). First, descriptives were conducted for symptoms counts of each individual diagnoses, and those which exhibited unacceptable skew (>|2|) and kurtosis (>|7|), were log transformed in order to reflect a more normal distribution. In substance users, and undergraduate students, the following variables were log transformed because they exhibited skew and kurtosis outside the acceptable range: MDD current symptoms: 2.24 and 3.79 respectively; PD past symptoms 3.58 and 12.60 respectively; PTSD 2.97 and 8.78 respectively, current DD: 5.85 and 36.71. In both studies the following variables were calculated according to the same procedure. A max count was taken across current and past MDD symptoms to create a variable that indexed symptoms of MDD ever experienced. A composite variable for anxiety was calculated by taking the mean z-score of symptoms for these three disorders (current GAD, current PTSD, and lifetime PD). A composite variable for current substance dependence was calculated by taking a max count of dependence symptoms across drug classifications. A max count for current alcohol dependence symptoms was calculated.

National College Health Risk Behavior Survey (NCHRBS; Center for Disease Control, 1995). Both studies (substance users and undergraduate students) received the NCHRBS, a 77-item questionnaire that assesses six areas of behavior that affect the morbidity and mortality of adolescents and young adults. The CDC (Center for Disease Control) revised the instrument in 1995 for a total of 96 questions. NCHRBS is the first national survey to measure health risk behaviors among undergraduate students in all six areas. The six areas of health behavior remained unchanged behaviors that contribute to unintentional and intentional injuries; tobacco use; alcohol and other drug use; sexual behaviors that contribute to unintended pregnancy and STDs; unhealthy dietary behaviors; and physical inactivity. A max count was performed for two areas of alcohol use and drug use in the past year.

Appendix D. USF IRB Approval Letter

USF
UNIVERSITY OF
SOUTH FLORIDA

DIVISION OF RESEARCH INTEGRITY AND COMPLIANCE
Institutional Review Boards, FWA No. 0000166
12901 Bruce B. Downs Blvd., MDC035 • Tampa, FL 33612-479
(813) 974-5638 • FAX (813) 974-561

January 17, 2012

Marina Bornovalova, PhD
Psychology
PCD 4118G

RE: **Approved** Amendment Request
IRB#: MS3_Pro00003592
Title: A longitudinal evaluation of distress tolerance

Dear Dr. Bornovalova:

On 12/16/2011 the Institutional Review Board (IRB) reviewed and approved your Amendment by full board review procedures.

The submitted request has been approved **from date:** 12/16/2011 **to date:** 4/16/2012 for the following:

Protocol Document(s):
Longitudinal Study Of Distress Tolerance(0.16)

Consent Document(s):
DT Longitudinal Consent .pdf(0.02)
Dt Longitudinal Consent DAACO.pdf(0.01)

-Change of study site (DACCO) because we want to evaluate this study in a substance using population at a residential treatment center. It is likely that some, if not all, of the DACCO participants could meet the definition of prisoner (46 CFR 46.303(c) if they are at DACCO to receive court ordered/mandated treatment on an inpatient basis . Therefore, with the addition of this prisoner population, the study's review category is changed from Expedited to Full Board.
-Change to procedure for administering assessment, i.e. they are specific to the sample we are assessing (substance abusers versus college students)
-Change to measures in the study, such that some are specific to the college sample and some are specific to the substance abusing population
-Change of monetary compensation in consent form because the consent form reflects the wrong amount of monetary compensation.
-Two consent forms for each population studied (college students and substance users from DAACO) because we are evaluating this study in two different populations two consent forms are necessary, one for college students, and one for substance users from DACCO.
-Change to SONA points because length of study is actually 2 hours instead of 1.5 hours and

Appendix D. Continued

both the SONA script and points awarded need to reflect that
-Change to study staff, we have hired new volunteer RAs.
-Change of study title because we are looking at two different populations, the title is incorrect, it is no longer in college students only, therefore we are changing the title to Longitudinal Evaluation of Distress Tolerance.

Please be reminded of the need to provide the letter of support from the DOC, which probationary individuals are considered to be housed under, stating that the DOC agrees to your research, supports the study, and allows these probationary individuals to participate in the study. No DOC participants should be enrolled into the study until you have submitted a separate amendment that includes the DOC letter of support

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

John A Schinka, Ph.D.

John Schinka, PhD, Chairperson
USF Institutional Review Board