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MMPI-2 Personality Disorder Spectra Scales

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Abstract

We describe updated and revised MMPI-2 scales for personality disorder (PD) using Loevinger's (1957) integrated construct validation (CV) approach to guide scale development. Dimensionalized PD "Spectra" scales were constructed out of the item pool of all previous MMPI-2 PD scales using content validity, item-analytic, and external criterion comparisons. Relationships between MMPI-2 PD Spectra scales and known marker variables and other self-report PD scales were studied in multiple, international data sets. We also examined the scale properties when scored from the MMPI-2-RF. PD Spectra scale items were cross-walked with the DSM-5 Alternative Model of Personality Disorder (AMPD) pathological personality traits, permitting convergent and discriminant validation with published PD prototypes. Our results indicated PD Spectra scales demonstrate strong substantive, structural, and external CV, including convergent and divergent correlations with external PD variables, incremental validity, and correspondences with dimensional PD prototypes. We also provide normative data for clinical and community populations. In conclusion, the PD Spectra scales enhance contemporary MMPI-2 assessment of PD, retain the clinical utility of familiar PD categories, and show meaningful correspondences with the AMPD.

Contemporary MMPI-2 Personality Disorder Spectra Scales

Assessment of personality disorder (PD) is a key concern to the mental health practitioner and investigator alike. The *Minnesota Multiphasic Personality Inventory* (second edition [MMPI-2]; Hathaway, McKinley, Butcher, Dahlstrom, Graham, & Tellegen, 1989) is a psychological assessment instrument of significant historical, investigative, forensic, and general clinical importance. We examined assessment of PD with the MMPI-2 in a series of studies, resulting in the development of revised and updated PD scales for this popular instrument. The studies used multiple large and international clinical samples, thereby buttressing the generalizability of the findings.

Three main sets of personality disorder (PD) scales for the MMPI/MMPI-2 are presently available. These are the scales of Morey, Waugh, and Blashfield (1985), Somwaru and Ben-Porath (1994), and Levitt and Gotts (1995). Research has shown that they generally show adequate convergent validity (Hicklin & Widiger, 2000; Jones, 2005), varying levels of psychometric adequacy, and points of clinical applicability (e.g., Morey, Blashfield, Webb, & Jewell, 1988).

However, discriminant validity is more problematic, and the item composition of these sets of PD scales have surprisingly low levels of item overlap (Hicklin & Widiger, 2000; Jones, 2005). These observations justify the project of refining and updating assessment of PD with the MMPI family of instruments. As definitions and conceptualizations of PD have changed over the years and across the versions of the *Diagnostic and Statistical Manuals* (*DSM*s) of the American Psychiatric Association (APA) since 1980, MMPI-based assessment of PDs must contend with the emerging dimensional paradigm in psychopathology and PDs (e.g., Krueger & Markon, 2014; Widiger and Trull, 2007).

Shifting PD Paradigms

Conceptions of psychopathology and diagnostic nosology change over time. Such shifts reflect conceptual, methodological, professional, and sociological forces acting on the field (Blashfield, Keeley, Flanagan, & Miles, 2014). Zachar and Kendler (2017) argue that psychiatric nosology currently is undergoing a Kuhnian *crisis of confidence* driven in part by the emerging paradigm of dimensional diagnosis. This is particularly salient in the realm of PDs (e.g. Bernstein, Iscan, & Maser, 2007; Verheul, 2005; Widigher & Trull, 2007). The paradigm under challenge, categorical PD by criterion-count, was formalized in *DSM-III* (APA, 1980). This model represented a "neo-Kraepelinian," descriptivist paradigm that emphasized diagnostic reliability and reduced influences of the Meyerian psychosocial and psychodynamic points of view of the time (Blashfield et al., 2014; Grob, 1991). Although the criterion-count structure of the *DSM-III* PD was a significant departure from previous *DSM*s, many of the PD *syndromes* of earlier *DSM*s were operationalized within *DSM-III* (e.g., *DSM-II*; APA, 1968; paranoid, schizoid, obsessive compulsive, hysterical, and antisocial). However, it is interesting that, with relatively minor changes in wording and emphases, the *DSM* PD diagnostic criteria have not changed substantially across *DSM-III* to *DSM-5* (APA, 2013; Morey & Benson, 2016). In part, this reflects the historically contingent aspect of psychiatric classification (Kendler, 2009).

Presently, the dimensional paradigm in psychopathology is gaining significant momentum (e.g., Caspi, et al., 2014; Kotov et al., 2017; Kotov, Ruggero, Krueger, Watson, Yuan, & Zimmerman, 2011; Krueger & Markon, 2006), and PDs are increasingly conceptualized dimensionally (e.g., Gore & Widiger, 2013; Hopwood et al., 2018; Krueger & Markon, 2014; Livesley, 1987; Simms, Goldberg, Roberts, Watson, Welte, & Rotterman, 2011; Wright & Sims, 2014). Disciplinary competition between traditional categorical and dimensional paradigms is reflected in the two visions of PD diagnosis contained within the *DSM-5* (APA, 2013). Section II maintains the traditional categorical *DSM-IV* (APA, 1994) PD nosology, and Section III offers a hybrid categorical-dimensional approach, the Alternative *DSM-5* Model of PDs (AMPD). Several recent overview articles have highlighted the strengths and utility of this alternate approach (e.g., Krueger, Hopwood, Wright, & Markon, 2014; Morey, Benson, Busch, & Skodol, 2015; Waugh, Hopwood, Krueger, Morey, Pincus, & Wright, 2017).

PD Paradigms in the MMPI

The dimensional paradigm presents an existential challenge to the existing MMPI-2 PD scales (i.e., Morey et al, 1985; Somwaru & Ben-Porath, 1994; Levitt & Gotts, 1995) with multiple prongs. These include questions as to the proper taxonomic unit (e.g., category versus dimension or a hybrid categorical-dimensional approach), the informational value of continuous versus dichotomous measurement (Markon, Chmielewski, & Miller, 2011), and the oft-noted pervasive problem of symptom heterogeneity and diagnostic co-morbidity associated with classical

categorical PD nosology. In addition to these challenges, because the original MMPI was developed by the empirical criterion-keying method (i.e., scales were keyed to traditional diagnostic groups; see Wiggins, 2003) and the existing MMPI-2 PD scales similarly reference traditional *DSM*-defined PD syndromes, it is an open question as to whether the existing psychometric infrastructure of MMPI-based PD assessment can be retrofitted or reconciled with the dimensional PD paradigm.

An important innovation within the MMPI-2 for assessing dimensional PD-related constructs was the Personality Psychopathology-Five (PSY-5; Harkness & McNulty, 1994; Harkness, McNulty, & Ben-Porath, 1995). The PSY-5 extended the "Big Five" or "lexical" tradition (Goldberg, 1993) within the assessment of normal personality traits to the arena of pathological personality traits. The PSY-5 scales are considered well-validated and standard PD trait reference dimensions in MMPI-related assessment (Harkness, Finn, McNulty, & Shields, 2012). In addition, the MMPI-based family of instruments now includes the MMPI-2-RF (Ben-Porath & Tellegen, 2008), an instrument offering conceptual and psychometric innovations, also broadly connecting MMPI-based assessment to dimensional models of personality and psychopathology (e.g., internalizing and externalizing dimensions). The MMPI-2-RF emphasized scale homogeneity and discriminant relations in contrast to the empirical criterion keying approach of its parent instruments. The PSY-5 scales and, more generally, the MMPI-2-RF, may be considered exemplars of the dimensional paradigm extended to MMPI-based PD assessment. Thus, the ability of the MMPI-2 to assess PD should be reckoned against these exemplars. Careful reckoning, however, considers complexities of scale development strategy, evidence for incremental validity of new scales (Hunsley & Meyer, 2003), the communicative value and clinical utility of the scale constructs, as well as connections with dimensional models of PD.

Sellbom, Waugh, and Hopwood (2018) described the development of MMPI-2-RF PD Spectra scales. The Sellbom et al. (2018) PD scales represent a "hybrid" approach to MMPI-based PD assessment. Recognizing pragmatic advantages to the traditional PD diagnostic rubrics (i.e., communicative value and clinical utility for the practicing clinician) along with the theoretical desirability of simultaneously drawing on both categorical and dimensional paradigms (Zachar & Kendler, 2017), they constructed PD scales based on traditional PD category names using the MMPI-2-RF item pool. Importantly, they followed a combined content validity, rational-theoretic, internal consistency, and external validity approach in developing PD scales and demonstrated incremental predictive value with respect to the existing PSY-5 benchmarks. This rationale and logic (as well as similar but non-identical methods) were employed in our MMPI-2 PD scale studies reported below, resulting in the development of revised and updated PD scales.

As noted, there are compelling reasons to re-visit PD assessment with the MMPI-2. The instrument remains very popular with clinicians (Camara, Nathan, & Puente, 2000) and is the most frequently taught self-report measure of this type (Mihura, Roy, & Graceffo, 2017; Ready & Veague, 2014). Furthermore, despite the rise of the dimensional paradigm in PD studies, the traditional *DSM*-based PD rubrics enjoy clinical utility with practitioners, and these PD syndromes are associated with deep theoretical and empirical knowledge bases (Shedler et al., 2010). The Sellbom et al. (2018) scales demonstrated success in bridging assessment of traditional PD rubrics with the MMPI-2-RF. Recognizing the importance of these issues, an updating of PD assessment with the MMPI-2 becomes inherently relevant to multiple practice stakeholders (e.g., in behavioral medicine, public-safety personnel screening, forensic psychology, and traditional clinical practice). Our objectives in updating MMPI-based PD assessment included evaluating the ability of the item pool to support psychometrically refined PD scales based on the "best" of the items drawn from

previous PD scales, maintaining connection with traditional PD syndrome concepts, and coordinating with dimensional PD models and existing MMPI-based exemplars.

Overview of Legacy MMPI PD Scales

Efforts to assess PD with the MMPI family of instruments began with Morey, Waugh, and Blashfield (1985). The authors, who modeled the scales after the *DSM-III* (APA, 1980), applied a combined rational-theoretical and internal consistency-based scale development strategy. They developed 11 PD scales, which demonstrated satisfactory psychometric properties and associations with *DSM-III* PDs (see also Morey, Blashfield, Webb, & Jewell, 1988).

Somwaru and Ben-Porath (1994) developed the next set of PD scales. These scales used the MMPI-2 items and were modeled to reflect *DSM-IV* (APA, 1994) PD criteria. Hicklin and Widiger (2000) studied the convergent validity of the Somwaru and Ben-Porath (1994) and Morey et al. (1985) PD scales, along with items from the Millon Clinical Multiaxial Inventory (3rd edition [MCMI-III] Millon, Millon, & Davis, 1994), Personality Diagnostic Questionnaire (4th edition [PDQ-4] Hyler, 1994), and Personality Assessment Inventory (PAI; Morey, 1991). They concluded the Somwaru and Ben-Porath (1994) scales were generally comparable to those of Morey et al. (1985) and showed strong convergent correlations with MCMI-III, PDQ-4, and PAI scales.

Using *DSM-III-R* (APA, 1987) criteria and both the MMPI and MMPI-2, Levitt and Gotts (1995) developed a third set of MMPI-2 PD scales. Jones (2005) compared the incremental validity of each of these three sets of MMPI-2 PD scales with respect to the MCMI-II and concluded both the Somwaru and Ben-Porath (1994) and Levitt and Gotts (1995) scales demonstrated some points of incremental validity over the Morey et al. (1985) scales. The Somwaru and Ben-Porath (1994) scales also showed the highest levels of internal consistency, ranging from good to excellent (when characterized by Cicchetti's [1994] descriptions).

Raskin and Novacek (1989) and Wink and Gough (1990) developed MMPI narcissism scales. Both sets of scales demonstrated adequate psychometric properties. However, since their development, conceptualizations of narcissistic personality pathology have broadened in scope. Previously, conceptions of narcissism emphasized the element of grandiosity in narcissistic PD. As contemporary views of narcissistic PD include the concept of narcissistic vulnerability (Cain, Pincus, & Ansell, 2008), there is concern the scales of Raskin and Novacek (1989) and Wink and Gough (1990) may not reflect this more differentiated view of narcissistic pathology.

Development of the MMPI-2 PD Spectra Scales: Overview

Theodore Millon, a key figure in the field of PD, recently used the rubric *Spectra* to refer to combined categorical and dimensional PD assessment (Grossman, 2015; Millon & Strack, 2015). Like Sellbom et al. (2018), we employed the term *Spectra* to describe PD dimensions referencing traditional PD syndromes, recognizing that dimensionalized syndrome scale concepts subsume empirically correlated constructs and remain clinically meaningful by their rubrics.

In approaching scale construction, we followed Loevinger's (1957) integrative model of construct validity (CV). This model regards CV as consisting of three partially overlapping programs of investigation: *substantive*, *structural*, and *external* validation. The substantive aspect is concerned with content validity issues, the structural component with construct-method fidelity and item/scale structural relations, and the external aspect of CV addresses convergent, discriminant, and predictive validation.

In constructing updated PD scales, we were cognizant of multiple psychometric strategies and choice points. There are several scale development strategies available and they can be described as empirical, factor analytic, rational-theoretical, rational-intuitive, and stylistic (Hase & Goldberg, 1967), or, more generally, as inductive (factor-analytic), deductive (rational-theoretic), and empirical (Burisch, 1978). Jackson (1970) articulated a sequential approach in which response style, rational, internal consistency, and empirical components are formally considered. Broadly speaking, the original MMPI represented the empirical approach. The MCMI scales represent the theoretical-deductive model, the NEO-Personality Inventory-Revised (NEO-PI-R; Costa & McCrae, 1990) and the Personality Inventory for *DSM-5* (PID-5; APA, 2013) are exemplars of the factor-analytic/internal consistency strategy. As is noted below, the PSY-5 scales employed a combined rational and internal consistency strategy, with an initial emphasis on content validity concerns. Notably, the early MMPI PD scales (e.g., Morey et al., 1985) also began with a content validity focus and selected items rationally, followed by internal consistency analysis. Modern points of view on scale construction argue the value of integrating multiple strategies (Morey, 2003). Thus, our scale development strategy deliberately was integrative, seeking conceptual relevance and clinical utility by selecting candidate items on a rational-theoretic basis, drawing from a wide pool of items with prior demonstrated relationships to PD. These considerations embody the principles of substantive validity (Clark & Watson, 1995; Loevinger, 1957). Subsequently, internal consistency and empirical item-analytic procedures were deployed, subjecting items to convergent and discriminant comparisons, as the scale composition was refined. This ensured structural validity concerns were included (Clark & Watson, 1995; Loevinger, 1957).

Finally, convergent and discriminant relationships of the new, updated PD scales with external measures of PD, including their incremental predictive value with respect to existing marker variables, were evaluated. This included comparison with dimensional PD variables, the ability of the updated PD scales to be cross-walked with the dimensional AMPD paradigm, and examining relationships with the Sellbom et al (2018) MMPI-2-RF-based PD scales. This series of studies constituted initial external validation CV (Loevinger, 1957). Implementing this multi-level CV approach required decisions on titrating psychometric parameters pertaining to degree of scale homogeneity, item overlap, construct complexity, and correlational relationships with external criteria. For example, rather than *a priori* seeking maximal internal consistency and scale homogeneity, we deliberately accepted inevitable tradeoffs amongst differing psychometric parameters because we sought to devise PD scales capable of addressing our multiple objectives. Our purposes were broad: seeking to refine and update, retain connections with traditional PD rubrics, and introduce connections with the dimensional paradigm of PD assessment. To do so, we incorporated elements and techniques from all strategies of scale construction.

Method and Results

Substantive Component of Construct Validity. Construct validity (CV) concerns apply at the item level (Clark & Watson, 1995; Loevinger, 1957). We began with the assumption that PD Spectra scales would not (and should not) be maximally homogenous or factorially pure because the Spectra scales are designed to reflect empirically correlated constructs (likely at different levels of the factor hierarchy), which covary in clinically meaningful ways and generally correspond to traditional syndrome conceptions. Although narrow-band constructs and scale homogeneity tend to be prioritized in contemporary psychometrics (see McGrath, 2005; Smith & McCarthy, 1995), we opted to balance these concerns by admitting a degree of construct complexity--as is reflected in traditional PD conceptions. We assumed that maximizing internal consistency, very high levels of scale inter-item correlation, and factorial purity (see Morey, 2003; Streiner, 2003), at the expense of a broad span of substantive item content, could attenuate the integrity of scales designed to index clinically-familiar PD constructs.

Consensus Item-Metric Analyses for the Initial Item Pool. To incorporate *substantive* aspects of CV in scale development, we started with the combined set of all items from existing MMPI-2 PD scales (Levitt & Gotts, 1995; Morey et al., 1985; Raskin & Novacek, 1989; Somwaru & Ben-Porath, 1994; Wink & Gough, 1990). This is an important point; our initial item pool was defined as the MMPI-2 items previously validated as relevant to PD. This ensured a basic platform of substantive CV.

The items of the existing PD scales were pooled, their scale membership de-identified, and the items randomized (386 items in total). Next, we employed a procedure not unlike that of Harkness and McNulty (1994) with their PSY-5. However, rather than lay raters, we relied on raters with expertise, and they were asked to draw on PD conceptions from multiple diagnostic nosologies as well as their clinical and scientific understanding of PDs. Harkness and McNulty (1994) sought to apply the Big Five, lexical approach to the domain of personality pathology, using the MMPI-2 item content. Harkening to the historical lexical approach, they characterized their project as referencing the "pages of a diagnostic manual," as opposed to a dictionary (p. 1; Harkness & McNulty, 1994). Using a large pool of lay raters, they asked raters to evaluate the degree to which the test items reflected core PD dimensional constructs related to the Big Five. In contrast, our initial steps were broader. Using MMPI-2 PD items with previously established empirical evidence of relevance to PD, expert raters were asked to refer to three "diagnostic manuals" (and their general knowledge of PD) and evaluate the degree to which candidate items reflected multiple PD nosological syndromes, concepts, and dimensions.

Members of the research team selected sixteen target syndromes from the *DSM-IV*/*DSM-5* (APA, 1994, 2013), International Classification of Diseases Mental and Behavioral Disorders (*ICD-10;* World Health Organization [WHO], 2015), and Psychodynamic Diagnostic Manual (Second Edition; *PDM-2*; Lingiardi & McWilliams, 2017). These were the target constructs the expert raters considered in evaluating putative MMPI-2 PD items for content validity. The syndromes were: antisocial, avoidant, borderline, dependent, depressive, histrionic, narcissistic (depleted/vulnerable), narcissistic (grandiose), obsessive-compulsive, paranoid, passive-aggressive, sadistic, schizoid, schizotypal, self-defeating, and somatizing. The raters were five psychologists and one advanced clinical psychology doctoral student with expertise in PDs. The mean years of clinical experience for the raters was 24.5 (SD = 15.4), ranging from four to 46 years.

The raters were asked to judge each MMPI-2 item by two criteria. These were (1) the direct *content validity* of the item for a given PD, as content validity is a central consideration in self-report test items (e.g., Duff, 1965; Holden & Jackson, 1979); and (2) *performative validit*y (i.e., how a person with a given PD might respond to the item; Johnson, 2004). This latter evaluative criterion seeks to capture the clinical and phenomenological complexity that may be involved in an individual's response to a self-report test item. Notably, this property, rather than the direct face value of item content, was emphasized early in the history of personality assessment (Meehl, 1945). This perspective recognizes that direct item content is not the sole determinant to responses to test items. Factors such as one's ability to introspect, willingness to disclose, and stylistic personality features can affect responses to verbal items (see Bornstein, 2011). In applying *performative validity* concerns, the judges were asked to consider how a person *with a given PD might respond to the item*, treating item response both as a social act (i.e., a performance; Johnson, 2004) as well as an interpersonal communication (Leary, 1957). Raters also were instructed to base their decisions on their scientific and clinical understanding of the PDs and to consult the *DSM-5* Section II (APA, 2013), the *ICD-10* (WHO, 2015), and the *PDM-2* (Lingiardi & McWilliams, 2017) references in addition to other resources, as desired. We purposely asked raters to view PDs broadly--as reflected in these construct-complex PD nosologies--at this phase so as cast a wide net for potentially useful PD items, a key aspect of substantive CV (Clark & Watson, 1995; Loevinger, 1957). Raters were asked to rate each item for each of the 16 PDs, using the following metric: 0 = "*not relevant*," 1 = "*somewhat relevant*", 2 = "*quite relevant*", and 3 = "*highly relevant*."

To determine whether raters considered items to be specifically relevant (not just reliably rated) to the personality constructs in question, content validity ratios (CVR) were calculated for the 16 identified personality syndromes. The CVR is calculated with the following formula, where *N* is the total number of experts and *E* is the number of experts who rated the item as essential (i.e., a rating of 2 or 3; Lawshe, 1975; Lynn, 1986):

$$\text{CVR} = (\text{E} - N/2) / (N - 2)$$

CVR metrics for the 16 putative personality syndromes were calculated. The CVR can range from -1 to +1; a value of less than 0 suggests that fewer than 50% of the raters feel that the item is essential, a value greater than 0 suggests that more than 50% of the raters feel that the item is essential, and a value of 1 suggests that all raters feel that the item is essential. Overall, 14 of the 16 personality syndromes achieved adequate-to-good CVRs, with values ranging from approximately .7 to .8 (qualitative descriptors from Gilbert & Prion, 2016). These included schizotypal, sadistic, paranoid, avoidant, antisocial, depressive, somatizing, schizoid, borderline, histrionic, dependent, passive-aggressive, narcissistic (grandiose), and obsessive compulsive personality syndromes (see Table 1 for mean CVRs).

Table 1

CVR analyses for personality syndromes identified from the DSM-IV, DSM-5, ICD-10, and PDM-2

Scale	Item Total	*M*	*SD*
Antisocial	29	.82	.17
Avoidant	19	.84	.17
Borderline	27	.77	.15
Dependent	22	.76	.15
Depressive	19	.79	.16
Histrionic	13	.77	.16
Narcissistic (depleted)	N/A	N/A	N/A
Narcissistic (grandiose)	21	.74	.14
Obsessive compulsive	20	.75	.15
Paranoid	14	.86	.17
Passive Aggressive	4	.75	.17
Sadistic	8	.88	.17
Schizoid	10	.77	.16
Schizotypal	12	.90	.16
Self-Defeating	1	.67	N/A
Somatizing	16	.79	.17

Item Pool Refinement. PD scale items were retained for further analysis if they were associated with a CVR of $\geq .67$[1]. This criterion reflects 2/3 of the raters considered the candidate items highly relevant to the parent PD syndrome. In the cases where items overlapped on CVR values (i.e., high CVRs on two or more PD scales), the item with the highest CVR was retained and it was deleted from the other scale(s). For example, if an item had a CVR of .67 on the schizoid scale and a CVR of 1.00 on the avoidant scale, the item was deleted from the schizoid scale and retained on the avoidant scale. If items were rated equally on two or more scales, discussion between raters was used to reach consensus on the best match of item to scale membership. We purposefully eliminated overlapping items to avoid artificial correlations among the scales caused by shared items. Although our PD scales were expected to consist of correlated constructs, we wanted to avoid potentially spurious correlation due to item overlap. In a few cases, items of modest CVR ratings (i.e., .33; 1/3 of the raters considered it highly relevant) were retained for a PD scale if strong theoretical rationale supported its inclusion. Furthermore, a decision was made to require that each seed scale possess a minimum number of 10 items so that the scale had sufficient items to permit deletion of poor-performing items, if needed, and preserve enough item numbers to assess internal consistency metrics. An inclusion threshold of 10 is arbitrary but offers a common-sense yardstick for seed scale length.

The following 12 PD seed scales demonstrated 10 or more items, strong CVRs, and non-overlapping status: antisocial, avoidant, borderline, dependent, depressive, histrionic, narcissistic (grandiose), obsessive compulsive, paranoid, schizoid, schizotypal, and somatizing. Passive

[1]It is worth noting that the initial criterion for rater item assignment agreement used in development of the PSY-5 scales was 51% (of 114 lay raters). Very approximately, this is similar to a 0 CVR value. In contrast, our procedure required a higher level of item agreement (mostly a .67 CVR), but with fewer raters (see Harkness et al., 1995). This comparison is inexact and illustrative only since the item selection procedures differed in other ways.

aggressive, narcissistic (depleted/vulnerable), and self-defeating PDs did not meet criteria for retention in subsequent analyses and thus scales for them were not developed. These 12 PD seed scales were next subjected to item-analytic study subsumed within the structural component of CV.

Structural Component of Construct Validity and Item Composition of the Spectra Scales. The *structural* component of CV involved internal consistency analyses in multiple clinical and community samples, stepwise iterative empirical item-analyses, and exploratory factor analysis (EFA) of the PD Spectra scales at the scale level.

Clinical development sample. Empirical item analyses of candidate MMPI-2 PD scales were conducted on data from a sample of patients who had completed the MMPI-2 (years 2005 to 2015). These were patients seen in an outpatient psychological clinic associated with a doctoral program in clinical psychology in the southeastern United States. The clinic operates on a sliding scale and serves a diverse local community, receiving referrals from mental health practitioners, the court system, universities, community members, primary care, and surrounding outpatient mental health centers. Thus, the patient population is likely broader than typical university-based counseling centers. The final sample (*N* = 1,030) included patients with the following demographics: mean age of 31.63 (*SD* = 11.63), 52.5% female (*n* = 541); mean years of education 14.38 (*SD* = 2.57); and 53.7% never married, 25.8% currently married. Specific diagnoses of the patients were not available for the current study, but the clinic typically sees a range of psychopathology that includes affective and anxiety disorders, adjustment disorders, attention-deficit hyperactivity disorder (ADHD) and learning disorders, and PDs. Descriptive statistics for commonly accepted MMPI-2 variables indicative of psychological disturbance suggest a sufficient range of psychopathology was present in scale construction samples (mean F = 63T; [*SD* = 15]; mean RCdem= 63T; [*SD* = 13]; Es = 66T [*SD* = 10]; replication sample data). Inclusion criteria for valid MMPI-2 profiles were the following: Cannot Say $\leq$ 30, VRIN < 80T, F and FB $\leq$ 110, Fp $\leq$ 100, L $\leq$ 80 T, K $\leq$ 75T, and S $\leq$ 75 T. These criteria are commonly used in MMPI-related research and were followed by Sellbom et al. (2018) in their recent work on PD scales for the MMPI-RF.

Empirical item analytic procedures and assembly of the final scales. Using the entire sample (*N* = 1,030), Cronbach's alpha and corrected item-total correlations for each item[2] and parent scale were examined. Items with an item-total correlation < .20 were excluded from further analyses. Each item was then evaluated for discriminant correlation with the scale totals of all other PD scales. Thus, if an item correlated higher with another PD scale than with its parent PD scale, it was flagged for further examination.

A total of 100 items were identified as non-divergent. These items then were evaluated by two members of the research team using theory as a guide for placement with its parent versus with the other PD scale. Agreement was reached on 90/100 identified items (kappa = .85). A third member of the research team rated the remaining 10 items, and the item was retained on the scale upon which two out of three raters agreed. Following this procedure, the schizoid scale dropped below 10 items. Consequently, one item was recruited from the Golden and Meehl (1979) study of the schizoid taxon within the MMPI item pool (i.e., item 12), and raters agreed to its inclusion in order to provide a 10th item for the scale.

[2]All MMPI-2 analyses utilize raw non-gendered scores unless otherwise noted.

We then randomly split the clinical sample into development (n = 614[3]) and replication samples (n = 416). We split the clinical sample to provide a way to determine whether the initial results found in the development sample would replicate.

The full item analytic procedure described above was then repeated for the development sample. Items were retained on a PD scale based a corrected item-total correlation of $\geq$ .20 and lack of a non-significant higher correlation (p < .01, 2-tailed) with non-parent PD scale. This resulted in the following number of item deletions: antisocial (5), borderline (3), dependent (2), depressive (1), histrionic (2), narcissistic (1), obsessive-compulsive (3), paranoid (2), schizoid (2), schizotypal (4), and somatizing (1). All items were retained on the avoidant PD scale. See Table 2 for the descriptive statistics of each PD scale in the development phase.

Table 2

Descriptive statistics MMPI-2 Spectra scales in developmental and replication samples

Scale	*N*	Scale *M*	*a*	Item-Total Correlation *M*
Antisocial				
Developmental (26 items)	614	7.89 (*SD* = 4.55)	.81	0.34 (*SD* = 0.07)
Replication (25 items)	416	7.64 (*SD* = 4.24)	.79	0.32 (*SD* = 0.07)
Avoidant				
Developmental (19 items)	614	7.88 (*SD* = 4.89)	.86	0.46 (*SD* = 0.12)
Replication (19 items)	416	8.18 (*SD* = 5.24)	.88	0.50 (*SD* = 0.13)
Borderline				
Developmental (30 items)	614	11.14 (*SD* = 6.49)	.88	0.40 (*SD* = 0.10)
Replication (28 items)	416	11.07 (*SD* = 6.22)	.87	0.41 (*SD* = 0.09)
Dependent				
Developmental (12 items)	614	4.80 (*SD* = 3.00)	.76	0.40 (*SD* = 0.11)
Replication (11 items)	416	4.50 (*SD* = 2.87)	.77	0.42 (*SD* = 0.11)
Depressive				
Developmental (30 items)	614	11.91 (*SD* = 7.17)	.92	0.49 (*SD* = 0.10)
Replication (30 items)	416	12.60 (*SD* = 7.19)	.92	0.49 (*SD* = 0.11)
Histrionic				
Developmental (17 items)	614	8.28 (*SD* = 4.04)	.80	0.39 (*SD* = 0.11)
Replication (17 items)	416	8.31 (*SD* = 4.17)	.82	0.42 (*SD* = 0.14)
Narcissistic (grandiose)				
Developmental (15 items)	614	9.00 (*SD* = 3.30)	.76	0.36 (*SD* = 0.06)
Replication (15 items)	416	8.66 (*SD* = 3.32)	.77	0.38 (*SD* = 0.07)
Obsessive compulsive				
Developmental (14 items)	613	6.26 (*SD* = 3.06)	.70	0.31 (*SD* = 0.06)
Replication (14 items)	416	6.34 (*SD* = 2.96)	.68	0.29 (*SD* = 0.08)
Paranoid				
Developmental (16 items)	614	4.38 (*SD* = 3.34)	.80	0.40 (*SD* = 0.06)
Replication (16 items)	416	4.64 (*SD* = 3.28)	.78	0.38 (*SD* = 0.07)
Schizoid				

[3]*N* for each PD scale varied slightly. Subjects were retained for PD item comparisons if 80% of the items for a given PD were answered. Final *N*s varied from 966 to 1007.

Developmental (9 items)	610	3.09 (*SD* = 2.31)	.73	0.41 (*SD* = 0.10)
Replication (9 items)	415	3.28 (*SD* = 2.50)	.78	0.47 (*SD* = 0.11)
Schizotypal				
Developmental (16 items)	614	2.48 (*SD* = 2.34)	.69	0.29 (*SD* = 0.06)
Replication (15 items)	416	2.50 (*SD* = 2.33)	.70	0.31 (*SD* = 0.08)
Somatizing				
Developmental (21 items)	614	6.59 (*SD* = 4.19)	.81	0.37 (*SD* = 0.07)
Replication (21 items)	416	6.68 (*SD* = 4.08)	.79	0.35 (*SD* = 0.08)

We performed the same empirical item analyses on the PD scales using the replication sample. After an examination of corrected-item total correlations and discriminant correlations, the following numbers of items were deleted: antisocial (1), borderline (2), dependent (1), and schizotypal (1). All items were retained on the avoidant, depressive, histrionic, narcissistic, obsessive compulsive, paranoid, schizoid, and somatizing PD scales. In five cases, items were retained for conceptual reasons and their prior item-analytic performance, despite a lack of > .2 item-total correlation on replication (i.e., #530 on borderline, #112 on histrionic, #410 on obsessive-compulsive, #118 on somatizing, and #198 on schizotypal).

Following the above sequential steps in scale construction, the initial item pool of 386 PD-related MMPI-2 items were winnowed to a set of 220 items from which the final 11 PD Spectra scales were composed. Descriptive statistics for the final scales are presented in Table 3, and a full listing of items by scale is listed in Appendix A[4].

Table 3

Cronbach's alpha for MMPI-2 Spectra scales and RF scales in various samples

AUTHOR Spectra Scale	Jones (2005)	Rossi et al. (2003)	MMPI-2 Restandardization Sample
Antisocial	.86	.78	.77
Avoidant	.88	.84	.82
Borderline	.90	.86	.82
Dependent	.84	.78	.67
Depressive	.94	.91	.85
Histrionic	.80	.74	.76
Narcissistic	.83	.73	.67
Obsessive Compulsive	.75	.58	.56
Paranoid	.87	.77	.76
Schizoid	.80	.63	.65
Schizotypal	.87	.72	.67
Somatizing	.85	.82	.67

[4]We acknowledge and thank the University of Minnesota Press for permission to list the item numbers and direction of scoring.

Scale	Sellbom RF in Jones (2005)	Mulay et al. RF in Jones (2005)	Sellbom RF in Rossi et al. (2003)	Mulay et al. RF in Rossi et al. (2003)
Antisocial	.85	.80	.78	.73
Avoidant	.88	.81	.83	.77
Borderline	.92	.87	.88	.81
Dependent	.87	.79	.82	.77
Depressive	N/A	.92	N/A	.88
Histrionic	.78	.79	.69	.71
Narcissistic	.66	.82	.64	.71
Obsessive Compulsive	.76	.54	.67	.42
Paranoid	.85	.84	.69	.66
Schizoid	.82	.74	.71	.55
Schizotypal	.91	.87	.78	.70
Somatizing	N/A	.75	N/A	.71

Internal consistency analyses. In several subsequent analyses, we used two additional large clinical datasets to evaluate the psychometric properties of the Spectra scales. The Jones (2005) sample consisted of 494 psychiatric patients (367 inpatients, 127 outpatients) from a large United States military medical center. Demographic characteristics of the Jones (2005) sample were as follows: 343 men (69.4%) and 151 women (30.6%); mean age of 29.8 (*SD* = 9.8); mean education of 13.5 years (*SD* = 2.6); 67.2% White, 23.2% African American, 4.7% Hispanic, 2.3% Asian, 0.6% American Indian, and 2.1% listed their race as other. The Rossi, Van den Brande, Tobac, Sloore, and Hauben (2003) sample consisted of 477 Belgian participants; this included correctional inmates (48.3%), psychiatric inpatients (35.6%), inpatients in a general clinic (0.7%), therapeutic community inpatients (3.8%), and outpatients (11.6%). With permission and the generosity of the University of Minnesota Press, we also report analyses based on the MMPI-2 re-standardization sample, which was composed of 2,600 individuals (1,138 men and 1,462 women) from seven states (i.e., California, Minnesota, North Carolina, Ohio, Pennsylvania, Virginia, and Washington; see MMPI-2 manual, pp. 3-4).

Table 3 shows results of Cronbach's alpha coefficients (technically, Kuder-Richardson coefficients since the items are dichotomous) for the PD Spectra scales in these samples. Since reliability is sample-specific, these are presented for the development and replication samples as well as the Jones (2005), Rossi et al. (2003), and MMPI-2 re-standardization data sets. In addition, for comparison purposes and general interest, alpha coefficients were calculated for abbreviated versions of the PD scales using their corresponding items on the MMPI-2-RF, as well as the Sellbom et al. (2018) PD scales. Results showed generally strong, yet not excessively high, internal consistency for the PD Spectra scales across samples. However, the values for the obsessive compulsive PD Spectra scale were modest in the Rossi et al. (2003) sample, as were the RF-versions of this scale and the schizoid scale. Alpha coefficients in the MMPI-2 normative sample were generally satisfactory with the exception of less robust figures for the obsessive compulsive scale. Descriptive statistics for the PD Spectra scales within the scale development clinical sample along with the Jones (2005), Rossi et al. (2003), and the restandardization samples are presented in Table 4.

Table 4

Descriptive statistics of MMPI-2 Spectra scales in various samples

	MMPI-2 Restandardization Sample		Clinic Outpatient Sample		
Spectra Scale	Men (n = 1138)	Women (n = 1462)	All (N = 1024)	Men (n = 486)	Women (n = 538)
Antisocial	8.19 (SD = 4.18)	5.72 (SD = 3.50)	7.91 (SD = 4.45)	9.27 (SD = 4.58)	6.67 (SD = 3.96)
Avoidant	6.21 (SD = 4.14)	6.99 (SD = 4.52)	8.00 (SD = 5.03)	7.37 (SD = 4.92)	8.57 (SD = 5.07)
Borderline	7.46 (SD = 4.83)	9.26 (SD = 5.27)	11.24 (SD = 6.44)	10.51 (SD = 6.54)	11.95 (SD = 6.29)
Dependent	2.80 (SD = 2.16)	3.64 (SD = 2.50)	4.89 (SD = 2.99)	4.40 (SD = 3.01)	5.32 (SD = 2.90)
Depressive	5.55 (SD = 4.73)	6.37 (SD = 5.15)	12.19 (SD = 7.18)	11.58 (SD = 7.29)	12.74 (SD = 7.04)
Histrionic	8.96 (SD = 3.73)	9.60 (SD = 3.36)	8.29 (SD = 4.09)	8.68 (SD = 4.07)	7.94 (SD = 4.08)
Narcissistic	10.44 (SD = 2.81)	9.51 (SD = 2.87)	8.86 (SD = 3.31)	9.52 (SD = 3.21)	8.27 (SD = 3.29)
Obsessive Compulsive	6.43 (SD = 2.55)	5.98 (SD = 2.50)	6.29 (SD = 3.02)	6.44 (SD = 3.08)	6.15 (SD = 2.96)
Paranoid	3.27 (SD = 2.81)	2.85 (SD = 2.65)	4.49 (SD = 3.32)	4.64 (SD = 3.41)	4.35 (SD = 3.24)
Schizoid	2.29 (SD = 1.93)	2.12 (SD = 1.82)	3.16 (SD = 2.39)	3.07 (SD = 2.36)	3.25 (SD = 2.41)
Schizotypal	1.92 (SD = 2.05)	1.94 (SD = 2.08)	2.49 (SD = 2.34)	2.67 (SD = 2.49)	2.34 (SD = 2.19)
Somatizing	3.33 (SD = 2.67)	3.81 (SD = 3.13)	6.62 (SD = 4.14)	5.89 (SD = 3.88)	7.29 (SD = 4.26)

	Rossi et al. (2003)			Jones (2005)		
	All (N = 469)	Men (n = 344)	Women (n = 125)	All (N = 539)	Men (n = 378)	Women
Antisocial	9.63 (SD = 4.48)	10.31 (SD = 4.53)	7.77 (SD = 3.77)	8.69 (SD = 5.30)	9.45 (SD = 5.42)	6.91 (SD = 4.57)
Avoidant	8.63 (SD = 4.68)	7.97 (SD = 4.47)	10.41 (SD = 4.82)	8.89 (SD = 5.24)	8.78 (SD = 5.20)	9.16 (SD = 5.31)
Borderline	10.99 (SD = 5.85)	9.66 (SD = 5.44)	14.58 (SD = 5.38)	12.00 (SD = 6.97)	11.45 (SD = 6.94)	13.30 (SD = 6.91)
Dependent	4.45 (SD = 2.91)	3.85 (SD = 2.66)	6.10 (SD = 2.94)	4.38 (SD = 3.25)	4.17 (SD = 3.16)	4.86 (SD = 3.40)
Depressive	11.63 (SD = 7.09)	10.09 (SD = 6.56)	15.81 (SD = 6.79)	13.99 (SD = 8.75)	13.60 (SD = 8.74)	14.93 (SD = 8.75)
Histrionic	7.71 (SD = 3.57)	7.86 (SD = 3.61)	7.30 (SD = 3.44)	7.55 (SD = 4.05)	7.77 (SD = 4.02)	7.04 (SD = 4.09)
Narcissistic	8.49 (SD = 3.17)	9.03 (SD = 3.02)	7.03 (SD = 3.11)	8.98 (SD = 3.84)	9.28 (SD = 3.78)	8.30 (SD = 3.90)
Obsessive Compulsive	6.48 (SD = 2.64)	6.33 (SD = 2.75)	6.87 (SD = 2.28)	6.80 (SD = 3.31)	6.92 (SD = 3.35)	6.52 (SD = 3.22)
Paranoid	6.04 (SD = 3.36)	5.78 (SD = 3.38)	6.75 (SD = 3.21)	6.97 (SD = 4.45)	7.14 (SD = 4.37)	6.59 (SD = 4.62)

Schizoid	3.63 (SD = 2.05)	3.46 (SD = 2.11)	4.08 (SD = 1.84)	4.17 (SD = 2.70)	4.15 (SD = 2.73)	4.21 (SD = 2.65)
Schizotypal	3.29 (SD = 2.64)	2.99 (SD = 2.43)	4.13 (SD = 2.98)	4.25 (SD = 3.92)	4.35 (SD = 3.94)	4.03 (SD = 3.87)
Somatizing	6.55 (SD = 4.29)	5.55 (SD = 3.76)	9.25 (SD = 4.46)	7.35 (SD = 4.91)	6.76 (SD = 4.71)	8.72 (SD = 5.13)

Note. MMPI-2 restandardization norms provided by the University of Minnesota Press. Use does not imply endorsement of the MMPI-2 Spectra scales by the University of Minnesota Press.

Factor analytic description of the PD Spectra scales. To assist in describing the internal structure of the Spectra scales, we performed an exploratory factor analysis (EFA) using data from the scale construction sample (N = 1,030). A maximum likelihood (ML) factor extraction was suitable for these data because variable kurtosis and skewness indicated approximate normality, the Kaiser-Meyer-Olkin measure of sampling adequacy (.87) was excellent, and Bartlett's test of sphericity was significant (χ^2 [66] = 2455.26, p < .001). Given we assumed PD dimensions were correlated, we applied an oblique rotation. Multiple criteria confirmed a two-factor solution (e.g., eigenvalues > 1.00, inspection of the scree plot; [Cattell, 1966], factor loadings, and parallel analysis [using 1000 randomly generated data sets with corresponding eigenvalues]). Thus, two correlated factors (r = -.28) were extracted.

See Table 5 for factor loadings. Factor 1 was interpreted as general severity of PD dysfunction. The three highest loadings were borderline, paranoid, and depressive, with 10 of the 12 PD Spectra scales showing loadings >.4. Factor 2 was defined by high positive loadings of narcissistic and histrionic, and strong negative loadings of avoidant and schizoid. Factor 2 was interpreted as a PD dimension of extroversion-externalizing PD pathology. This ML analysis was repeated on the 10 Spectra scales corresponding to the PD syndromes included in the *DSM-IV/5* (omitting somatizing and depressive). This also produced two correlated factors (-.23 correlation) with highly similar factor loadings.

Table 5

Factor loadings of MMPI-2 Spectra scales

Spectra scale	Factor 1	Factor 2
Antisocial	.50	.04
Avoidant	.42	**-.77**
Borderline	**.80**	-.34
Dependent	.53	-.56
Depressive	**.72**	-.62
Histrionic	.02	**.63**
Narcissistic	-.16	**.78**
Obsessive compulsive	.68	-.16
Paranoid	**.72**	-.23
Schizoid	.44	-.70
Schizotypal	.66	-.16
Somatizing	.55	-.31

Note. Highest loadings bolded.

External Component of Construct Validity. To evaluate evidence for the external component of CV, the PD Spectra scales were studied in multiple ways. First, we explored item overlap and correlations with the PSY-5 scales because of their importance as well-known dimensions of personality pathology (see Table 6). Results were in the expected direction and magnitude. For example, correlations ranged from 0 for antisocial and Introversion/Low Positive Emotionality to .89 for borderline and Negative Emotionality. Importantly, these results also confirm the Spectra and PSY-5 scales are not isomorphic or redundant. Of the 60 possible correlations between Spectra and PSY-5 scales, only six possess $\geq$50% of shared variance (antisocial with Disconstraint; borderline with Negative Emotionality; depressive with Negative

Emotionality; histrionic with Introversion/Low Positive Emotionality; paranoid with Psychoticism; schizotypal with Psychoticism). Moreover, these relationships are not simply a function of item overlap. Across the 12 Spectra scales, the average percentage of *non-overlapping items* (i.e., not on a PSY-5) on a Spectra scale was 75%.

Table 6

MMPI-2 Spectra scale correlations with MMPI-2 PSY-5 scales in outpatient sample

	AGGR	PSYC	DISC	NEGE	INTR
Antisocial	.47	.44	.71**	.42	.00
Avoidant	-.29	.34	-.12	.48	.60*
Borderline	.26	.55*	.18	.89***	.33
Dependent	-.27	.38	-.07	.55*	.38
Depressive	-.02	.50	.10	.76**	.64*
Histrionic	.35	.05	.27	-.03	-.75**
Narcissistic	.58*	-.06	.13	-.29	-.65*
Obsessive compulsive	.36	.58*	.11	.58*	.09
Paranoid	.34	.78**	.11	.56*	.21
Schizoid	-.11	.37	-.02	.39	.67*
Schizotypal	.26	.75**	.22	.48	.09
Somatizing	.10	.37	.09	.48	.34

Note. N = 1,030. r .07 $p < .05$; r .09 $p < .01$. *denotes coefficient determination (r squared) $\geq$ 30%; ** = $\geq$ 50%; *** = > 79%. All calculations are based on raw, non-gendered, non-K-corrected scores. AGGR = aggression, PSYC = psychoticism, DISC = disconstraint, NEGE = negative emotionality, INTR = introversion/low positive emotionality.

Convergent and divergent relationships with counterpart PD scales. To further assess the external component of CV of the PD Spectra scales, correlations with counterpart PD scales were examined using the two large clinical data sets of Jones (2005) and Rossi et al. (2003). Correlations between the PD Spectra scales and their MCMI-II counterparts in the Jones (2005) dataset were as follows: antisocial (r = .73), avoidant (r = .77), borderline (r = .83), dependent (r = .52), histrionic (r = .70), narcissistic (r = .42), obsessive compulsive (r = -.06), paranoid (r = .66), schizoid (r = .74), and schizotypal (r = .67). Similar to Jones' (2005) original study of convergence and divergence with the early MMPI PD scales, we evaluated divergent correlations by tabulating the number of times a Spectra scale correlated higher with a non-counterpart PD on the MCMI-II. For example, if the Spectra avoidant PD scale were to correlate higher with the MCMI-II schizoid compared to its MCMI-II avoidant counterpart, it would constitute a failed divergent correlation. All Spectra scales demonstrated no failed divergent correlations except for (1) a single failed divergent correlation for the paranoid scale (with MCMI-II schizotypal at .73 versus .66), and (2) the obsessive-compulsive scale (which demonstrated nine failed divergent correlations).

Using the Rossi et al. (2003) clinical sample, we also studied convergent and divergent relationships of the PD Spectra scales with the MCMI-III counterpart PD scales. Correlations between the PD Spectra scales and their MCMI-III counterparts were as follows: antisocial (r = .67), avoidant (r = .72), borderline (r = .70), dependent (r = .73), depressive (r = .77), histrionic (r = .49), narcissistic (r = .60), obsessive compulsive (r = -.09), paranoid (r = .68), schizoid (r = .63),

and schizotypal (r = .56). As described above, we tabulated the number of failed divergent correlations of the Spectra scales with their non-counterpart MCMI-III scales. All Spectra scales showed no failed divergent correlations except for schizoid, which minimally failed divergence with a slightly stronger (negative) correlation with MCMI-III histrionic (.63 vs. -.64), and obsessive-compulsive, which again demonstrated nine failed divergent relationships.

Relationships with MMPI-2-RF PD scales. To offer points of reference to the MMPI-2-RF, we performed similar analyses using RF-abbreviated[5] versions of our PD Spectra scales, with the Sellbom et al. (2018) RF-PD scales, and their correlations with the MCMI-II/III counterpart PD scales. In the Jones (2005) data set, correlations between the RF-abbreviated versions of our Spectra scales and their MCMI-II counterparts were as follows: antisocial (r = .72), avoidant (r = .74), borderline (r = .82), dependent (r = .48), histrionic (r = .69), narcissistic (r = .41), obsessive compulsive (r = -.10), paranoid (r = .59), schizoid (r = .72), and schizotypal (r = .67). After z-transforming PD scale correlations, the mean correlation was .61. In the Rossi et al. (2003) data with the MCMI-III, correlations were as follows: antisocial (r = .63), avoidant (r = .70), borderline (r = .68), dependent (r = .68), depressive (r = .77), histrionic (r = .48), narcissistic (r = .59), obsessive compulsive (r = -.10), paranoid (r = .57), schizoid (r = .61), and schizotypal (r = .55). After z-transforming PD scale correlations, the mean correlation was .58.

Except for the obsessive-compulsive scale, moderate or greater convergence with counterpart PD scales is evidenced across samples. Note that the RF-abbreviated versions of the PD Spectra scales have fewer items (collectively 71% of the items compared to the full scales), which may be expected to affect indices of reliability and validity simply on a psychometric basis.

The abbreviated RF-versions of our PD Spectra scales were compared with those scored for the Sellbom et al. (2018) RF PD scales. Correlations of these two sets of PD scales were examined in both the Jones (2005) and Rossi et al. (2003) data sets. For the Jones (2005) sample, all but two correlations for the similarly named PD scales were above .8. They ranged from a high of .94 for avoidant and schizotypal to a low of .75 for obsessive-compulsive. In the Rossi et al. (2003) sample, seven correlations were above .8, and they ranged from a high of .92 for avoidant, with relatively lower values for obsessive-compulsive (.67) and schizoid (.65).

Item overlap between the full PD Spectra scales, their RF-abbreviated versions, and the Sellbom et al. (2018) RF-PD scales were compared. For our new PD Spectra scales, 70% of the items are scorable on the MMPI-2-RF. These total 133 items, and the Sellbom et al. (2018) RF-PD scales total 208 items. Thus, the two "versions" of RF PD scales share 84 items (63%; note: this does not include the dependent and somatizing scales, which are not included in the Sellbom et al. [2018] set). At the scale level, overlap ranges from a high of 60% for antisocial to a low of 13% for schizoid (mean item overlap of 41%). Despite the generally very strong correlations between our RF-abbreviated PD Spectra scales and those of Sellbom et al. (2018), item overlap varies.

Incremental validity of the PD Spectra scales. We investigated the variance in prediction of counterpart MCMI-III PD scales provided by the PSY-5 scales compared to the incremental contribution of the PD Spectra scales. For these comparisons, incremental predictive variance (relative to PSY-5 scores) in individual counterpart PD scale scores was determined for each PD Spectra scale (and for all PD Spectra scales combined) through a series of hierarchal linear multiple

[5]RF-abbreviated version refers to scoring the PD Spectra scales based only on items carried from the MMPI-2 to the MMPI-2-RF.

regressions (MR). The mean percent of variance across MCMI-III PD scales associated with the PSY-5 was 44% (range 20% to 53%). The mean percent variance contributed by individual counterpart PD Spectra scales was 50% (range 20% to 63%). Including all PD Spectra scales in the MRs, the mean percent of variance was 57% (range 35% to 67%). Thus, at an individual scale level, mean incremental variance was 6% for the counterpart PD Spectra scales, and collectively the PD Spectra scales provided 13% incremental variance over that of the PSY-5. The greatest incremental variance, when simultaneously considering all PD Spectra scales, was found for the MCMI-III avoidant (16%), borderline (16%), and dependent (17%) scales; relatively less incremental prediction from the PD Spectra scales was found for MCMI-III narcissistic (7%) scale. These results demonstrate evidence of incremental validity of the PD Spectra scales over the established PSY-5 scales, thus providing strong rationale for their use in further study and clinical application.

Correlations with the Personality Inventory for *DSM-5*. Using a Flemish community sample of 251 adult volunteers (62% female; mean age = 30 [*SD*=13.5]), the Dutch-language Personality Inventory for *DSM-5* (PID-5; APA, 2013; see Bastiaens et al., 2016) and the Dutch version of the MMPI-2 (Derksen, de Mey, Sloore & Hellenbosch, 2006) were administered and studied for interrelations. Correlations between the PD Spectra scales and the PID-5 trait domain and trait-facet scales are presented in Table 7. Results were very comprehensible, of moderate size, and in the expected direction. It is important to note that this was a community sample. Because both instruments assess pathological PD dimensions, restriction of range in the scores may affect the size of obtained correlation coefficients. One way to take stock of these many correlations is to consider expected convergent and divergent relationships between PID-5 trait-facet scales and PD Spectra scales in terms of their named correspondence with AMPD hybrid categorical-dimensional diagnoses. That is, for example, the AMPD algorithm for antisocial PD is defined by six or more positive ratings on seven PD traits: manipulativeness, callousness, deceitfulness, hostility, risk taking, impulsivity, and irresponsibility. In our data, considering the seven AMPD antisocial PD traits (i.e., manipulativeness, etc.), the median antisocial PD Spectra scale by PID-5 trait-facet convergent correlation was .44; the median divergent correlation was .25. Sellbom et al. (2018) performed a similar analysis with their RF-based PD scales and the PID-5 (also using a non-clinical sample). Notably, the pattern of findings in Table 6 is very similar to the results reported in Sellbom et al. (2018). Table 6 depicts in boldface the traits associated with AMPD hybrid categorical dimensional diagnoses in relation to the correspondingly named PD Spectra scales (note: the AMPD specifies trait configurations only for antisocial, avoidant, borderline, narcissistic, obsessive-compulsive, and schizotypal PD).

Table 7

Correlations between MMPI-2 Spectra scales and PID-5 in community sample

	ANT	AVD	BOR	DEPn	DEPr	HST	NAR	OCP	PAR	SOM	SZD	SZT
Negative Affectivity	.05	.37	.65	.49	.64	.07	-.30	.32	.32	.47	.24	.30
Anxiousness	.10	.42**	.57**	.50**	.67**	-.04	-.36**	.27**	.32**	.45**	.28**	.21**
Hostility	.43	.14*	.51**	.18**	.18**	.23**	.16**	.40**	.31**	.20**	.09	.29
Emotional Lability	.01	.20**	.61**	.36**	.46**	.08	-.22**	.27**	.27**	.41**	.14*	.32**
Perseveration	.26	.26**	.46**	.38**	.51**	.10	-.14*	.42**	.38**	.29**	.31**	.39**
Submissiveness	.01	.30**	.23**	.46**	.36**	.03	-.29**	.23**	.11	.16*	.25**	.01
Separation Insecurity	.13	.27**	.40**	.33**	.40**	.16**	-.18**	.24**	.18**	.27**	.14*	.14*
Depressivity	.12	.38**	.43**	.37**	.74**	-.10	-.31**	.22**	.34**	.36**	.41**	.33**
Detachment	.25	.40	.29	.27	.58	-.21	-.23	.30	.45	.32	.49	.19
Anhedonia	.24**	.46**	.26**	.21**	.59**	-.22**	-.25**	.23**	.32**	.22**	.53**	.15*
Withdrawal	.16*	.49**	.19**	.13*	.31**	-.33**	-.18**	.18**	.24**	.10	.61**	.21
Intimacy Avoidance	.01	.19**	.00	.16*	.22**	-.20**	-.19**	.06	.11	.08	.31**	.03
Restricted Affectivity	.34**	.19**	-.06	-.05	.18**	-.06	.01	.15*	.21**	.01	.39**	.15
Suspiciousness	.29**	.22**	.37**	.22**	.50**	-.03	-.03	.37**	.57**	.41**	.21**	.24**
Antagonism	.57	-.08	.17	.01	.06	.30	.31	.35	.24	.04	.02	.32
Attention Seeking	.40**	-.24**	.27**	.11	.12	.44**	.28**	.29**	.19**	.17**	-.07	.30**
Callousness	.60**	-.05	.19**	-.08	.07	.13*	.25**	.22**	.27**	.05	.11	.31**
Deceitfulness	.56**	.01	.18**	.11	.11	.31**	.19**	.32**	.25**	.07	.04	.26**
Grandiosity	.46**	-.06	.14*	-.08	.10	.15*	.27**	.28**	.22**	.06	.10	.40**
Manipulation	.45**	-.18**	.11	-.04	-.08	.28**	.36**	.30**	.14*	-.03	-.08	.18**
Disinhibition	.39	.09	.39	.28	.37	.30	-.06	.33	.35	.29	.15	.42
Impulsivity	.28**	-.02	.35**	.22**	.19**	.30**	.04	.26**	.30**	.30**	-.03	.25**
Irresponsibility	.44**	.03	.31**	.17**	.30**	.27**	.05	.29**	.33**	.14*	.11	.47**
Risk Taking	.31**	-.32**	.02	-.21**	-.09	.30**	.30**	.06	.08	-.12	-.12	.04
Distractibility	.29**	.17**	.32**	.28**	.40**	.21**	-.17**	.28**	.27**	.26**	.23**	.34**
Rigid Perfectionism	.10	.19**	.41**	.29**	.35**	-.01	-.06	.37**	.33**	.27**	.20**	.22**
Psychoticism	.36	.13	.38	.14	.40	.15	.02	.38	.37	.26	.28	0.62
Eccentricity	.36**	.15*	.32**	.13*	.36**	.15*	.01	.34**	.36**	.23	.30	.51**
Perceptual Distortion	.29**	.14*	.42**	.21**	.45**	.14*	-.06	.38**	.33**	.25	.23	.58**

Unusual Beliefs	.27**	.01	.28**	-.01	.23**	.10	.11	.25**	.26**	.19	.16	.60**

Note. $N = 251$. *$p < .05$, **$p < .01$. Items in bold indicate PID-5 traits corresponding to AMPD PD hybrid categorical-dimensional PD diagnoses. ANT = antisocial; AVD = avoidant; BOR = borderline; DEPn = dependent; DEPr = depressive; HIST = histrionic; NAR = narcissistic; OCP = obsessive compulsive; PAR = paranoid; SOM = somaticizing; SZD = schizoid; SZT = schizotypal.

EFA of PD Spectra, MCMI, and PSY-5 scales. To illustrate relationships between the MMPI-2 Spectra scales, MCMI-III counterpart PD scales, and PSY-5 scales, we performed an EFA with maximum likelihood (ML) using the Rossi et al. (2003) dataset. We did not include the somatizing Spectra scale in the EFA, as there is no scale counterpart in either the MCMI-III or the PSY-5. Variable kurtosis and skewness indicated approximate normality, the Kaiser-Meyer-Olkin measure of sampling adequacy (.90) was excellent, and Bartlett's test of sphericity was significant (χ^2 [351] = 12097.18, $p < .001$). Given the assumption the PD dimensions are correlated, we again applied an oblique rotation. Multiple criteria confirmed a five-factor solution (e.g., eigenvalues > 1.00, inspection of the scree plot; [Cattell, 1966], and factor loadings. See Table 8 for factor loadings. The pattern of loadings (highest PD Spectra scale noted) suggests factor I reflects PD severity and negative affectivity (borderline [.93], depressive [.82]), factor II involves antisocial PD traits (antisocial [.91]), factor III taps introversive/extroversive PD traits (histrionic [.73]), factor IV reflects paranoid thinking and psychoticism (paranoid [.71]), and factor V involves narcissistic traits and interpersonal insensitivity (Narcissistic [.64]). The PSY-5 scales and MCMI-III counterpart PD scales aligned with these dimensions in the expected directions.

Table 8

Factor analysis with MMPI-2 Spectra scales, PSY-5, and MCMI in Rossi et al. (2003)

Scales	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Antisocial Spectra	.17	.91	.18	.29	.16
Avoidant Spectra	.49	.02	-.63	.15	-.65
Borderline Spectra	.93	.23	-.29	.35	-.46
Dependent Spectra	.74	.09	-.35	.16	-.68
Depressive Spectra	.82	.13	-.53	.23	-.64
Histrionic Spectra	.07	.40	.73	.15	.13
Narcissistic Spectra	-.42	.03	.61	.25	.64
Obsessive compulsive Spectra	.59	.33	-.03	.53	-.14
Paranoid Spectra	.49	.23	-.15	.71	-.20
Schizoid Spectra	.40	.03	-.70	.24	-.37
Schizotypal Spectra	.58	.19	-.10	.55	-.19
PSY-5 AGGR	-.07	.42	.41	.49	.50
PSY-5 PSYC	.63	.26	-.13	.68	-.20
PSY-5 DISC	-.15	.82	.35	.04	.32
PSY-5 NEGE	.93	.21	-.33	.30	-.50
PSY-5 INTR	.32	-.13	-.86	-.13	-.46
MCMI Schizoid	.46	.07	-.66	.42	-.53
MCMI Avoidant	.58	.02	-.60	.38	-.87
MCMI Depressive	.74	.04	-.38	.36	-.71
MCMI Dependent	.67	.02	-.22	.26	-.76
MCMI Histrionic	-.32	.10	.81	-.20	.67
MCMI Narcissistic	-.21	.23	.58	.23	.71
MCMI Antisocial	.23	.74	.16	.26	-.002
MCMI Compulsive	-.30	-.46	.12	.03	.20
MCMI Schizotypal	.65	.17	-.40	.65	-.65
MCMI Borderline	.74	.32	-.27	.39	-.59

MCMI Paranoid	.46	.20	-.17	.80	-.30

Note. AGGR = aggression, PSYC = psychoticism, DISC = disconstraint, NEGE = negative emotionality, INTR = introversion/low positive emotionality.

Cross-walking the PD Spectra scales with the AMPD. In order to evaluate the extent to which the PD Spectra scales interdigitate with the dimensional PD model of the AMPD, we characterized PD Spectra scale items in terms of the AMPD traits. We did this by rating the items of each PD Spectra scale for the degree to which they reflected the presence of AMPD traits. Three authors provided ratings of the PD Spectra scale items with the 25 AMPD traits of the *DSM-5* (APA, 2013). The traits of the AMPD are: anhedonia, anxiousness, attention seeking, callousness, cognitive and perceptual distortion, deceitfulness, depressivity, distractibility, eccentricity, emotional lability, grandiosity, hostility, impulsivity, intimacy avoidance, irresponsibility, manipulativeness, perseveration, separation insecurity, submissiveness, suspiciousness, restricted affect, rigid perfectionism, risk taking, unusual beliefs and/or experiences, and withdrawal. Raters used the following metric: 0 = "*not relevant*," 1 = "*somewhat relevant*", 2 = "*quite relevant*", and 3 = "*highly relevant*." Mean AMPD ratings of each PD scale are available upon request from the first author. This procedure served to represent the items of the PD Spectra scales in the vocabulary and metric of Criterion B of the AMPD. The items so coded were averaged for the PD Spectra scales, thus producing an AMPD "trait profile" associated with the item content of each PD Spectra scale.

We substantiated inter-rater reliability (IRR) by evaluating rater performance in characterizing the borderline, narcissistic, and obsessive-compulsive PD Spectra scale items with the AMPD trait-facets. For the borderline Spectra scale, the 2-way, random effects, absolute agreement intraclass correlation coefficients (ICC) were .87 and .95 (single and mean). The ICCs for the narcissistic and obsessive compulsive scales were also excellent: narcissistic = .95 and .98 (single and mean); obsessive compulsive = .96 and .98 (single and mean). These levels of agreement indicate the raters were characterizing PD Spectra scale items with excellent IRR and therefore could support the following procedure designed to explicitly cross-walk the PD Spectra scales with the dimensional AMPD.

This project made use of AMPD prototypes associated with *DSM* PDs as determined by Morey, Benson, and Skodol (2016). Morey et al. (2016) reported data on AMPD trait configurations associated with *DSM-IV* (APA, 1994) PD criterion count sums from a study based on a national sample of 327 clinicians. Convergent and divergent correlations for each PD Spectra scale with the AMPD PD prototypes from Morey et al. (2016) were obtained. We implemented a cross-walk between the PD Spectra scales (based on item ratings for the 25 trait-facets of the AMPD) by correlating the AMPD mean values of the PD Spectra scales with the AMPD PD prototypes of Morey et al. (2016). These comparisons revealed very robust connections between the PD Spectra scales and their corresponding Morey et al. (2016) PD prototypes. Notably, each PD Spectra scale was significantly correlated with its Morey et al. (2016) PD counterpart in the expected direction, and there were no failed discriminant correlations (see Table 9). The mean convergent correlation was computed (after transforming values into *z* scores) across all the 10 Spectra scales with their counterpart Morey et al. (2016) PD profiles (note: depressive and somatizing do not have counterparts). The mean convergent correlation was .72, and the mean divergent correlation (absolute values) was .27. The difference between the mean convergent and absolute value divergent correlation was significant ($z = 2.09$; $p < .01$, one-tailed). In terms of individual PD scale-level comparisons, the convergent and divergent correlations for antisocial,

borderline, dependent, obsessive compulsive, paranoid, schizoid, and schizotypal were significantly different at $p < .05$. The MMPI-2 PD Spectra scales for avoidant, histrionic, and narcissistic did not achieve significance, however. In sum, the PD Spectra scales demonstrated robust convergent and discriminant correlations with their corresponding AMPD-based PD prototypes.

Table 9

Correlations of AMPD trait-facet profiles of MMPI-2 Spectra scales with Morey, Benson, & Skodol (2016) PD to AMPD profiles.

	Morey, Benson, & Skodol (2016) AMPD ratings										
	ANT	AVD	BOR	DEPn	HST	NAR	OCP	PAR	SZD	SZT	Severity
Antisocial	**.80****	-.63**	.39	-.34	.60**	.55**	-.55**	.33	-.51**	-.41*	.52*
Avoidant	-.55**	**.63****	-.37	.34	-.59**	-.58**	.14	-.54**	.47*	.11	-.52*
Borderline	.21	-.14	**.76****	.12	.16	.07	-.33	.29	-.25	-.23	.45*
Dependent	-.53**	.60**	.12	**.81****	-.31	-.59**	-.14	-.56**	-.05	-.17	-.48*
Depressive	-.72**	.68**	-.26	.41*	-.74**	-.72**	.27	-.49*	.52*	.24	-.40*
Histrionic	.29	-.30	.50*	.08	**.59****	.28	-.45*	-.02	-.54**	-.46*	.11
Narcissistic	.13	-.35	-.13	-.37	.28	**.50***	.32	.13	-.22	-.25	-.15
Obsessive compulsive	-.21	.04	-.30	-.15	-.20	-.05	**.70****	.06	.01	-.05	-.36
Paranoid	-.03	-.03	-.23	-.39	-.18	.08	.41*	**.62****	.36	.51*	.22
Schizoid	-.43*	.53**	-.53**	-.07	-.63**	-.42*	.35	-.27	**.91****	.62**	-.19
Schizotypal	-.27	.18	-.20	-.02	-.29	-.31	.00	.05	.26	**.66****	.09
Somatizing	-.28	.19	-.17	.20	-.23	-.30	.23	-.14	-.02	-.02	-.27

Note. $N = 25$. *$p < .05$, **$p < .01$. ANT = antisocial; AVD = avoidant; BOR = borderline; DEPn = dependent; HST = histrionic; NAR = narcissistic; OCP = obsessive compulsive; PAR = paranoid; SZD = schizoid; SZT = schizotypal. Bolded figures are convergent correlations.

Discussion

Based on results of multiple analytic strategies and using large samples of clinical subjects, we crafted revised and updated PD scales for the MMPI-2. Beginning with the pool of items from all extant MMPI-2-related PD scales, these items were subjected to sequential scale development analyses guided by Loevinger's (1957) multi-tiered approach to construct validation. The PD Spectra scales were designed to reflect dimensionalized versions of traditional PD conceptions, thereby preserving the clinical utility of the traditional PD syndrome rubrics. In addition to scale development results, we report descriptive statistics on the properties and norms of the PD Spectra scales in the development sample, two large clinical samples, and the community sample used in the MMPI-2 restandardization. These data provide preliminary but reasonably comprehensive community and clinical norms (presented in gendered and non-gendered formats) and may thereby inform interpretation of the scales in clinical practice.

Scale revision and construction began with candidate items from previously published MMPI-based PD scales, and these were winnowed first by rigorous CVR analyses of ratings made by multiple experienced raters. The focus on content validity ensured Loevinger's (1957) CV component of substantive validity was incorporated from the start. Iterative empirical item analyses of these candidate scale items, in both a development and replication sample, yielded final PD scales with robust psychometric properties. For example, Cronbach alphas ranged from .68 to .92, and item-total correlations ranged from .29 to .50, reflecting psychometric parameter values considered very acceptable (Clark & Watson, 1995; Streiner, Norman, & Cairney, 2015). The final PD Spectra scales are: antisocial, avoidant, borderline, dependent, depressive, histrionic, narcissistic (grandiose), obsessive-compulsive, paranoid, somatizing, schizoid, and schizotypal. The revised and updated PD Spectra scales have no item overlap, eliminating artificial correlations caused by shared items.

Structural aspects of CV (Loevinger, 1957) were evaluated using multiple large samples for internal consistency and factor analyses. Internal consistency results generally were strong except for more modest results for the obsessive-compulsive Spectra scale in the Rossi et al. (2003) and restandardization samples. Alpha coefficients were also lower for the schizoid scale, likely due to the smaller number of items on the scale (n = 9). A scale-level EFA of the PD scales demonstrated a two-dimensional structure consisting of a general severity dimension marked by 10 of the 12 Spectra scales. The highest loadings were for borderline, paranoid, and depressive PDs. This result is very consistent with findings from Sharp et al. (2015) who concluded that a general PD severity dimension (like Criterion A of the AMPD) underlies the dimensionality of PDs, when studied at the *DSM*-criterion level. As 10 of the 12 PD Spectra scales aligned on a severity dimension, this suggests a similar conceptualization also applies to the assessment of PD with the MMPI-2. The second factor dimension reflected extroversion or externalizing PD constructs, marked by high loadings for narcissistic and histrionic PD scales and negative loadings by avoidant and schizoid. This finding resembles the internalizing versus externalizing higher-order factor often found in multivariate analyses of psychopathology (Krueger, 1999) and in personality pathology (Krueger & Markon, 2014). A two-factor solution to a scale-level EFA is not surprising. For example, early factor-analytic investigation of the MMPI clinical scales generally found two factors, as prototypically represented by the Welsh A and R scales (Welsh, 1952; 1965). Similarly, recent studies of the MMPI-2 Restructured Clinical Scales have described a relatively small factor space (e.g., three factor dimensions; Hoelzle & Meyer, 2008). It is important to recognize the dimensionality of the PD Spectra scales does not reproduce the Cluster A, B, and C PD

configurations described in the modern *DSM*s. This result is also consistent with the empirical literature on psychometric scale and diagnosis-level PD analyses (Wright & Zimmerman, 2015).

A key aspect of scale development is incremental validity with respect to existing indices (Hunsley & Meyer, 2003). Accordingly, the PD Spectra scales were compared with the PSY-5 scales. Examination of shared variance and item overlap showed that the PD Spectra and the PSY-5 scales are not isomorphic. Most importantly, the PD Spectra scales (individually and collectively) added meaningful variance over the PSY-5 scales in predicting MCMI-III PD scale scores. These results also resemble the findings of Sellbom et al. (2018) who compared PD scales developed for the MMPI-2-RF with the PSY-5 and external criteria. While the finding of incremental predictive variance with our PD Spectra scales with respect to the more established PSY-5 scales is important (and provides a *raison d'etre* for the PD Spectra scales), we note that the MCMI-II/III PD scales represent an approximate rather than "gold-standard" criterion for PD. Additionally, the PD Spectra scales number twelve, compared to five for the PSY-5, thus providing more variables to be used in prediction. This latter property of the PD Spectra scales bears emphasis. We view the PD Spectra scales as empirically overlapping configurations of clinically-relevant traditional PD constructs. This is a very different conception than the more factorially pure PD dimensions of the PSY-5. Thus, the PD Spectra and PSY-5 scales are like the proverbial apples and oranges. They serve somewhat different purposes and should be regarded as complementary, rather than competing, approaches to the assessment of PD-related constructs. We suggest the PD Spectra and PSY-5 scales be used conjointly to inform PD assessment with the MMPI-based family of instruments.

The external component of CV (Loevinger, 1957) was further examined through PD Spectra scale relationships with MCMI-II and –III counterpart scales in two large clinical sample datasets (i.e., Jones, 2005 and Rossi et al., 2003). Convergent correlations between the PD Spectra scales and MCMI-counterpart PD scales were strong, with a single notable exception. The obsessive compulsive PD Spectra scale failed to significantly correlate with the compulsive scale of the MCMI-II or –III. There are several reasons for this finding. This *DSM*-based syndrome is multi-dimensional and has evolved over different versions of the *DSMs*. Studies of dimensionality of the syndrome by interview and self-report assessment find inconsistent results (e.g., Baer, 1994; Grillo, 2004). Notably, Samuel and Widiger (2010) argued the MCMI-III compulsive PD emphasized content more reflective of excessive conscientiousness when compared to the MMPI-2 version from Morey et al. (1985), which tapped more anxiety-related content. Also, they noted that differing coverage of specific *DSM* criteria in the items of these two OCPD scales. In sum, the MCMI-based compulsive PD scales cannot be regarded as true counterparts for MMPI-based obsessive compulsive PD scales.

A joint EFA of the PD Spectra, the MCMI-III counterpart PD, and the PSY-5 scales illustrated convergences among these PD measures. Using these variables as markers, five PD dimensions emerged. These were interpreted as general severity, antisocial, externalizing/extroversion, psychoticism, and narcissistic insensitivity PD dimensions. This analysis does not map the general multivariate space of PD but rather depicts the empirical convergences of these specific PD scales in relation to the PD Spectra scales. Importantly, the counterpart PD and the PSY-5 scales aligned in expected directions. These results are consistent with the idea that the PD Spectra scales are conceptually-related and clinically-familiar amalgams of underlying PD dimensions although they may be separable through factor analyses with bifactor methods, co-factoring with marker variables, and item-level studies. These results are also consistent with the general findings of van der Heijden, Egger, Rossi, and Derksen (2012), whose

study included some of the same subjects, but they looked at MMPI-2-RF and MCMI-III correspondences only. They found a four-factor solution, but it should be noted they did not include the PSY-5 scales as markers, which we did, thus permitting a fifth factor to emerge from the data.

Cross-connections between the PD Spectra scales and dimensional PD diagnosis (i.e., AMPD traits) were evaluated. Translating the item content of the PD Spectra scales into the AMPD scheme, they were compared with the Morey et al. (2016) AMPD profiles associated with *DSM* PD criterion count sums. Very strong convergent (.50 to .98; mean .72) and divergent correlations (mean .27) were found; there were no failed divergent correlations. Thus, when translated into AMPD trait vocabulary and metrics, the PD Spectra scales demonstrated excellent convergent and discriminant relationships with DSM-based PD prototypes. Correlations of the PD Spectra and PID-5 scales also demonstrated comprehensible and generally supportive results, an outcome which further informs interpretation of the PD Spectra scales and their alignment with the AMPD.

Although further study of the PD Spectra scales is needed prior to routine clinical application (at least as unaccompanied PD scales), they nonetheless can inform clinical practice. They possess strong psychometric properties originating from sophisticated CV-based scale construction, and they refer to traditional PD rubrics familiar to practitioners. It is also important to remember the PD Spectra scales have consolidated the "best" of previous empirical assessments of PDs with respect to the MMPI item pool. Clinically, MMPI-2 PD assessment may be enriched by examining the PD Spectra scales alongside the PSY-5 and other MMPI-based scales (e.g., validity scales, Content Scales, Restructured Clinical Scales, etc.). The PD Spectra scales offer the clinician additional elaboration and differentiation of PD constructs to assist nuanced MMPI-2 interpretation.

These studies of the PD Spectra scales are not without limitations. For example, the scale development sample lacked comprehensive demographic and diagnostic information despite being drawn from a clinical center that serves a diverse range of people and psychopathology and of sufficient size for psychometric analyses (N = 1,030). This concern is further mitigated by the use of two large, independent clinical samples representing a range of psychopathology. Another minor limitation is the reported correlations between the PD Spectra and PSY-5 scales are partly accounted for by shared items. However, the degree of overlap is surprisingly low. While the MCMI-family of PD assessment instruments cannot be considered a "gold standard" for PD, these instruments are commonly used in research and clinical assessment of PD, and therefore provide a reasonable approximate external criterion for study of the PD Spectra scales.

In addition, a few words about the use of clinical ratings in scale development and external validation are in order. First, we deliberately and strategically used clinical ratings to build in aspects of substantive validity (Loevinger, 1957) at the item level. Second, these analyses made use of skilled raters, some of whom possess outstanding expertise with the MMPI-family of instruments, and IRR was very strong. Third, external validation of the PD Spectra scales via convergent and divergent correlations with the Morey et al. (2016) AMPD-to-*DSM* PD prototypes utilized data from numerous multi-disciplinary clinician raters (N = 327) who were independent of the present study. Finally, as noted by Samuel (2015), agreement for ratings of PD by self-report and clinician report is enhanced when structured and dimensional metrics are used. Our studies leading to the development of the PD Spectra scales employed structured and dimensional metrics throughout. Furthermore, clinical description *ipso facto* is not a liability; when combined with reasoned psychometric strategies, it can promote enhanced statistical prediction (Westen & Weinberger, 2004). For all of these reasons, we do not consider the use of clinician ratings a

weakness but rather an important element of scale construction and validation of the PD Spectra scales, adding substantive CV and standing alongside our structural validity evidence and results from external validation by other measures of PD constructs.

The next step in validation is to further study additional external correlates of the PD Spectra scales. This should involve relevant multi-method approaches such as other self-report inventories; clinical correlates and life data; performance assessment; behavior, genetic, and family history variables; and treatment response data. For example, initial studies might use the PAI (Morey, 2001/2007) and non-self-report measures such as the Shedler-Westen Assessment Procedure (SWAP; Shedler & Westen, 2007). Evaluation of the psychometric properties of the Spectra PD scales in specialized clinical and forensic populations also is important because the MMPI-2 is used in diverse assessment contexts. Further study of cross-model convergent and discriminant relationships between the PD Spectra scales and alternate measurements of the AMPD (e.g., the PID-5 [APA, 2013]; Level of Personality Functioning Scale-Self-Report [LPFS-SR; Morey, 2017]; *DSM-5* Levels of Personality Functioning Questionnaire [DLOPF; Huprich et al., 2017]) is indicated. Similarly, the five-factor/Big-Five traditions offer self-report assessments for PD congruent with the AMPD (see Suzuki, Griffin, & Samuel, 2017). Addtionally, instruments from other dimensional models (e.g., Computerized Adaptive Assessment of PD; CAT-PD; Simms et al., 2011) of PD are ripe for study of empirical relationships with the PD Spectra scales. These instruments could be used to further articulate the nomological net and relative strengths and weaknesses of the PD Spectra scales in relation to contemporary dimensional PD models.

In sum, we report revised and updated MMPI-2 PD Spectra scales with strong psychometric properties. They were developed through sophisticated content validity and item analytic techniques, and they evidence promising initial CV across several large clinical samples. This includes favorable results from study of relationships with other self-report PD assessment instruments and PD constructs, including evidence of incremental predictive variance relative to the PSY-5 scales. Additionally, the PD Spectra scales perform well when scored in abbreviated fashion using the reduced number of items from the MMPI-2-RF and in relationship to the Sellbom et al (2018) RF-based PD scales. One important implication of these results is the items from the MMPI-family of instruments can support PD assessment.

The PD Spectra scales were cross-walked with the dimensional PD model of the AMPD. This exercise demonstrated that meaningful connections exist between categorical and dimensional PD conceptions within the PD Spectra scales—yet the PD Spectra scales preserve the clinical utility and communicative value of the traditional PD rubrics. Similar efforts to bridge traditional and dimensional PD diagnosis are emerging in the literature (e.g., Bach & Sellbom, 2016; Busch, Morey, & Hopwood, 2017; Evan & Simms, 2017; Sellbom et al. 2018). Another way to state this is the PD Spectra scales appear comprehensible (decomposable) within the larger HiTOP paradigm (Kotov et al., 2018) even if they are “packaged” with familiar PD rubrics and correlated clinical constructs. In these and other ways, the PD Spectra scales may further escort the MMPI-2 into the contemporary paradigm of dimensional PD assessment, while continuing to serve the important practical needs of the clinician performing diagnostic assessments of PD.

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Appendix A[6]

Listing of the Spectra Scales by MMPI-2 Item Number[7]

Antisocial (25 items)
27, 35, 41, 66, 81, 84, *100 (F)*, 105, 110, 123, 134, 240, 250, *266 (F)*, 269, 284, 324, 344, 412, 418, *429 (F)*, 431, 432, 540, 548
Avoidant (19 items)
46, *79 (F)*, 161, 167, 178, 185, 243, *262 (F)*, 265, 275, 289, 310, *321 (F)*, *335 (F)*, 337, *342 (F)*, *360 (F)*, 375, 446
Borderline (28 items)
23, 37, *63 (F)*, 82, 116, 146, 213, 215, 256, 271, 285, 288, 302, 328, *372 (F)*, 382, 386, 389, *405 (F)*, 430, 442, 444, 502, 513, 520, 530, 542, *564 (F)*
Dependent (11 items)
70, 127, 129, 348, 368, 421, 457, 491, 503, 509, 514
Depressive (30 items)
9 (F), 22, 38, 52, 56, *75 (F)*, 92, 130, *148 (F)*, 196, 273, 301, 303, 317, 339, 364, 377, *388 (F)*, 400, 408, 411, 415, 450, 454, 485, 516, 517, 539, 546, 556
Histrionic (17 items)
86, 112, 153, *158 (F)*, 169, 189, 207, 231, 242, 244, 340, 353, 359, 363, 370, 456, 552
Narcissistic (15 items)
61, *73 (F)*, 109, 120, 157, 239, 318, *326 (F)*, 345, 350, 365, 437, 452, 460, 521
Obsessive Compulsive (14 items)
55, 87, 135, 136, 212, 309, 313, 346, 356, 401, 423, 461, 535, 547
Paranoid (16 items)
42, 99, 124, 138, 225, 241, 259, 286, *314 (F)*, 315, 333, 358, 403, 445, 484, 549
Schizoid (9 items)
12 (F), *49 (F)*, *280 (F)*, 281, 349, 367, 391, 479, 480
Schizotypal (15 items)
32, 72, 168, 198, 298, 307, 311, 316, 319, 361, *427 (F)*, 448, 466, 508, 551
Somatizing (21 items)
3 (F), 28, *33 (F)*, 39, *45 (F)*, 53, *57 (F)*, *91 (F)*, 97, 101, 111, *118 (F)*, *141 (F)*, 149, *165 (F)*, *177 (F)*, *181 (F)*, *208 (F)*, 247, *295 (F)*, 536

[6]MMPI-2 PD Spectra Scales copyright by Abby L. Mulay and Mark H. Waugh.
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