

THE HIERARCHICAL FACTOR STRUCTURE OF THE PERSONALITY INVENTORY
FOR DSM-5

A Thesis

Presented to

The Faculty of the Department

of Psychology

University of Houston

In Partial Fulfillment

Of the Requirements for the Degree of

Master of Arts

By

Kiana Wall

August, 2019

THE HIERARCHICAL FACTOR STRUCTURE OF THE PERSONALITY INVENTORY
FOR DSM-5

An Abstract of a Thesis

Presented to

The Faculty of the Department

of Psychology

University of Houston

In Partial Fulfillment

Of the Requirements for the Degree of

Master of Arts

By

Kiana Wall

August, 2019

ABSTRACT

Section III of the DSM-5 contains a dimensional, trait-based Alternative Model for Personality Disorders (AMPD) as an area for future research, given proposals that a trait-based model of personality pathology may address inadequacies of the traditional categorical diagnostic model. Accompanying the AMPD is a trait-based, self-report measure of personality pathology – the Personality Inventory for DSM-5 (PID-5). The latent factor structure of the PID-5 is important given that it determines scoring procedures for the measure and helps inform the relationship between traits and the PD diagnoses in the AMPD, in other words, the latent structure of personality pathology. Therefore, it is necessary to consider this structure in great detail to ensure the structural validity and reliability of the measure and the AMPD moving forward. Against this background, the aim of the current study was to clarify the latent factor structure of the PID-5 using hierarchical confirmatory factor analysis (CFA) in a diverse, undergraduate student sample ($N = 983$). Results indicated that the majority of facet scales in the PID-5 were unidimensional. The psychoticism domain achieved acceptable model fit, but the others required modifications to achieve acceptable model fit. However, the entire hierarchical model of the PID-5 was not supported. Results of the current study call into question the hierarchical structure of the PID-5 for conceptualizing and assessing for personality pathology. Although domain scales of the PID-5 may reach acceptable levels of internal consistency and uni-dimensionality, the incremental utility of the domain scales over the facet scales in assessing for the presence of personality pathology remains in question. Further, the hierarchical structure of the PID-5 requires further investigation using item-level factor analytic techniques to compare alternative models to the structure proposed in the AMPD of the DSM-5.

TABLE OF CONTENTS

1. History of personality disorders in the DSM	1
2. Trait models and the conceptualization of personality pathology	2
3. The alternative model for personality disorders	4
4. The factor structure of the PID-5	7
a. Independent factor analytic studies	7
b. Independent factor analytic studies of translations of the PID-5	10
c. Joint factor analytic studies	12
d. Summary	14
5. Limitations of literature examining the latent factor structure of the PID-5	16
6. The current study	19
a. Aims	19
b. Hypotheses	20
7. Methods	20
a. Participants	20
b. Measures	22
c. Procedures	22
d. Data analytic strategy	23
i. Preliminary analyses	23
ii. Aim 1: clarify the latent factor structure of the PID-5 facets	23
iii. Aim 2: clarify the latent factor structure of the PID-5 domains	24
iv. Aim 3: clarify the hierarchical latent factor structure of the PID-5	25
8. Results	25

a. Preliminary analyses	25
b. Aim 1: results of CFA's of the PID-5 facets	26
c. Aim 2: results of CFA's of the PID-5 domains	27
d. Aim 3: results of CFA of the hierarchical PID-5 structure	28
9. Discussion	29
a. Limitations and future directions	34
10. References	36

LIST OF TABLES

Table 1: Proposed correspondence between domains of the FFM and the AMPD.....	46
Table 2: Factor analytic studies of the 220-item PID-5.....	47-53
Table 3: Descriptive statistics, internal consistency and CFA standardized loading summary statistics of the PID-5 facet and domain scales.....	54-55
Table 4: CFA model fit statistics of the PID-5 facet scales.....	56-57
Table 5: CFA model fit statistics of the PID-5 domain scales and hierarchical structure.....	58
Table 6: CFA standardized factor loadings of the unmodified antagonism domain model.....	59-60
Table 7: CFA standardized factor loadings of the unmodified detachment domain model.....	61-63
Table 8: CFA standardized factor loadings of the unmodified disinhibition domain model.....	64-65
Table 9: CFA standardized factor loadings of the unmodified negative affectivity domain model.....	66-67
Table 10: CFA standardized factor loadings of the unmodified psychoticism domain model.....	68-69
Table 11: CFA standardized facet factor loadings and domain covariance of the unmodified hierarchical PID-5 model.....	70-71
Figure 1: Hierarchical organization of the DSM-5 AMPD trait domains and facets.....	72
Figure 2: Proposed hierarchical latent factor structure of the PID-5.....	73

History of personality disorders in the DSM

Formal personality disorder (PD) diagnoses have been available since the first publication of the Diagnostic and Statistical Manual of Mental Disorders (DSM-I; APA, 1952) in 1952. At that time, twelve categorical diagnoses were described in paragraph form with no diagnostic criteria listed. Subsequently, DSM-I PD diagnoses demonstrated poor reliability and validity in research and practice (Coolidge & Segal, 1998). The DSM-II (APA, 1968), published in 1968, eliminated four PD diagnoses and added three for a total of ten. Disorder descriptions remained only a few sentences in length and still did not contain formal diagnostic criteria (Coolidge & Segal, 1998).

The release of DSM-III (APA, 1980) in 1980 marked a significant change in the conceptualization of PDs with the introduction of the multi-axial system and formal listing of numbered criteria and thresholds for each disorder (Coolidge & Segal, 1998). Axis I of DSM-III contained most mental disorders and syndromes. Axis II contained PDs and developmental conditions (i.e. intellectual disabilities). This distinction aimed to reflect the inflexible or pervasive nature of personality pathology. The listing of PD diagnostic criteria in DSM-III markedly increased the reliability and validity of PDs in research and practice. However, as a diagnostic category, the accuracy and replicability of PD diagnoses continued to lag behind other categories of the DSM (Coolidge & Segal, 1998).

Importantly, the DSM-III also revised the definition of PDs and conceptualized the disorders as collections of inflexible and maladaptive personality *traits* which cause distress or impairment in function. As Coolidge and Segal (1998) note, this definition change highlighted the inherent conflict between categorical DSM diagnoses and the dimensional nature of abnormal psychology and behavior. This conflict is particularly relevant to PDs

given the long history of dimensional, trait-based research in the field of normative personality (Cattell, 1946; Eysenck, 1947; Guilford, 1975) and longstanding debates regarding a trait model's validity in the assessment of maladaptive aspects of personality function (Block, 1995; Costa Jr & Widiger, 1994)

With the publication of DSM-III-R (APA, 1987), DSM-IV (APA, 1994), DSM-IV-TR (APA, 2000) and DSM-5 (APA, 2013), criteria for PD diagnoses were further refined and diagnostic clusters were reorganized and then eliminated in light of existing empirical evidence. As of the publication of DSM-IV, these revisions appeared to improve the reliability and validity of the category, overall (Coolidge & Segal, 1998). However, numerous problems within and between the categorical diagnoses continued to be observed. These included high rates of comorbidity, heterogeneity within diagnoses, the use of arbitrary cut-offs for diagnosis and the over-use of PD-not otherwise specified, suggesting that the categorical diagnoses available did not adequately or accurately capture the full range of personality pathology (Krueger & Eaton, 2010). Researchers proposed adopting a trait-based model of personality pathology in DSM-5 to address these inadequacies and to mirror the dimensional classification shift happening in the mental health field at large (Krueger et al., 2011). However, fully transitioning to a dimensional model is viewed by many as premature given concerns about complexity, clinical utility and clinical relevance of proposed models (Clarkin & Huprich, 2011; Herpertz et al., 2017; Shedler et al., 2010). Ultimately, the DSM-5 included a hybrid and trait-based model of PDs in section III as an area for future research and retained the categorical model of prior publications in section II.

Trait models and the conceptualization of personality pathology

The Five Factor Model of Personality (FFM; Goldberg, 1990; McCrae & John, 1992) is arguably the most well-researched trait model for understanding normative variation in personality. The five major dimensions of personality, according to the FFM include: extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience. These traits are purported to be stable (Soldz & Vaillant, 1999), at least somewhat heritable (Jang, McCrae, Angleitner, Riemann, & Livesley, 1998; Loehlin, McCrae, Costa Jr, & John, 1998), universal (McCrae & Costa Jr, 1997) and useful in clinical practice (Costa & McCrae, 1992). Common instruments used in the assessment of the “Big Five” traits include the Big Five Inventory (John, Donahue, & Kentle, 1991) and the NEO-PI-R (Costa Jr & McCrae, 1992). Researchers have proposed that the FFM and its accompanying measures are adequate for clinical use in assessment and diagnosis of PDs (Costa Jr & Widiger, 1994). Although four out of five domains of the FFM (neuroticism, extraversion, agreeableness and conscientiousness) are closely related to components of trait personality pathology, measures of the FFM are inadequate for capturing all relevant aspects of personality pathology including schizotypy and interpersonal dysfunction (Krueger et al., 2011).

Subsequently, utilizing normative trait personality measures such as the BFI or NEO-PI-R in a clinical setting, or to revise the PD diagnostic system, was deemed unsustainable by the DSM-5 workgroup given their lack of coverage of extreme pathological components of personality (Krueger et al., 2011). Trait-based models such as the Dimensional Assessment of Personality Pathology (DAPP; Livesley & Jackson, 2009), the Schedule for Non-adaptive and Adaptive Personality (SNAP; Clark, 1993), the Personality Psychopathology Five (PSY-5; Harkness, McNulty, & Ben-Porath, 1995) and the Dimensional Personality Symptom Item Pool (DIPSI; De Clercq, De Fruyt, Van Leeuwen, & Mervielde, 2006) were reviewed as they

are dimensional models and measures of trait personality pathology. Broadly, they have in common the same three to four domains which appear to represent maladaptive variants of the FFM traits. These include negative emotionality, introversion, antagonism and disinhibition (Krueger et al., 2011). Depending on the model, up to two additional domains of personality pathology emerge which require further investigation: compulsivity and a form of schizotypy or psychoticism. It was in the context of the FFM and these pre-existing models of trait-based personality pathology that the development of the DSM-5 alternative model for personality disorders (AMPD) took place.

The alternative model for personality disorders

To encourage further research into the feasibility and superiority of a dimensional diagnostic system for PDs, the AMPD was published in 2013 as part of section III of the DSM-5. Accompanying the AMPD is a trait-based, self-report measure of personality pathology – the Personality Inventory for DSM-5 (PID-5; Krueger, Derringer, Markon, Watson, & Skodol, 2012) and a clinician rating measure of self-other personality functioning – the Level of Personality Functioning Scale (LPFS; APA, 2013).

The AMPD lists seven general criteria for PDs. These include A) at least moderate impairment in self and interpersonal functioning and B) one or more pathological personality traits. Additionally, C) criteria A and B must be inflexible and pervasive, D) stable across time and traceable back to adolescence or young adulthood, E) not better explained by another mental disorder, F) not attributable to substances or other medical conditions and G) not developmentally or socio-culturally appropriate (APA, 2013).

Self-dysfunction in criterion A is defined as a (1) problem of identity and (2) of self-direction. Disturbed identity may manifest as inappropriate boundaries between the self and

others, unstable self-esteem and a reduced ability to regulate emotions. Problems in self-direction may include a lack of consistent goal-setting or pursuit and difficulty in self-reflection. Interpersonal-dysfunction in criterion A is defined as impairment in (1) empathy and (2) intimacy. Impairments in empathy may result in a reduced ability to reflect on the perspectives, motivations and emotions of others. Problems with intimacy may mean one has a lack of meaningful, long lasting, fulfilling relationships and/or a lack of desire or ability to initiate and maintain such interpersonal relationships. Criterion A may be assessed using the LPFS which contains four components corresponding to the criterion description – identity, self-direction, empathy and intimacy. Clinicians use the LPFS to rate patient’s impairment level (none, moderate, severe, extreme) on each component and a determination is made as to whether or not the individual meets diagnostic threshold for criterion A (moderate or greater impairment in self and other function).

Criterion B allows clinicians to identify a PD diagnosis as antisocial, avoidant, borderline, narcissistic, obsessive-compulsive or schizotypal using personality traits. There are twenty-five maladaptive personality trait facets listed in the AMPD for assessment of criterion B. These twenty-five facets are organized under five higher-order personality domains (Figure 1). The five domains are negative affectivity, detachment, antagonism, disinhibition and psychoticism. This structure mirrors that of the FFM and is similar to the PSY-5 (Table 1; APA, 2013). The maladaptive personality traits that compose criterion B may be assessed using the full self-report form of the PID-5, published by the American Psychiatric Association (APA). After completion and scoring, the patients’ twenty-five trait facet scores on the PID-5 may be compared and matched to proposed elevated facets for each disorder in the AMPD. For example, a diagnosis of borderline personality disorder (BPD) in

the AMPD requires four or more elevated facets from a list of seven: emotional lability, anxiousness, separation insecurity, depressivity, impulsivity, risk-taking and hostility. At least one of the four elevated facets must be impulsivity, risk taking or hostility.

The PID-5 was developed by Krueger et al. (2012, pg. 1880) who aimed to “synthesize existing models” of trait-based personality pathology to advance a dimensional model for personality pathology assessment in the DSM-5. The PID-5 is composed of 220 statement items (i.e. I rarely get enthusiastic about anything) rated on a scale of 0 (very false or often false) to 3 (very true or often true). Personality trait facet scores are computed by reverse-scoring (when necessary), totaling and averaging indicated items for that facet. Personality trait domain scores are computed by totaling and averaging the indicated facet scores for that domain. Although no “cut-off” scores have been formally proposed for interpretation of average trait facet and domain scores, some have suggested an average score of 2 as “elevated” (Samuel, Hopwood, Krueger, Thomas, & Ruggero, 2013).

Initial development and construction of the measure by Krueger et al. (2012) took place in three rounds. Participants were recruited online with the aim of being representative of and generalizable to the adult population of the United States. In round one, 296 items assessed thirty-seven facets of personality pathology in a sample of 762 selected participants who reported ever having received therapy or counseling. In round two, 65 items were removed and 85 new items were added to the battery, resulting in a total of 316 items aimed at improving trait facets not reliably assessed in round one. In round three, the final 220 items of the published PID-5 were examined in a representative sample of 264 participants. Although the authors confirmed that all thirty-seven facets from round one and two could be reliably measured, exploratory factor analysis (EFA) suggested that these could be reduced to

twenty-five – which were analyzed in round three. In round three, although indices for factor extraction suggested three-, five- and six-factor high-order structures, the five-factor solution was extracted as it was “readily interpretable”, theoretically (Krueger, et al., 2012, pg. 1886). Therefore, the final version of the PID-5 is suggested to capture twenty-five core facets of personality pathology that organize under five higher-order trait domains.

The latent factor structure of the PID-5 is important given that it is purported to mirror scoring procedures of the measure and assignments of the trait domains and facets to PD diagnoses in the AMPD, in other words, the latent structure of personality pathology. Therefore, it is necessary to consider this structure in great detail to ensure the validity and reliability of the measure and AMPD moving forward. Although research into the utility of the PID-5 has flourished since its publication in 2012 (Krueger et al., 2012), work considering the factor structure of the PID-5 is relatively limited. Here, factor analytic work utilizing the English version of the PID-5 will be reviewed in detail. Factor analytic work on translations of the PID-5 will also be briefly summarized, as will studies considering the “joint” factor structure of the PID-5 with other measures of personality and psychopathology.

The factor structure of the PID-5

Independent factor analytic studies

Although the original publication of the PID-5 (Krueger et al., 2012) found support for the measures five-factor structure, there are concerns of note. Firstly, a number of trait facets substantially cross-loaded (loadings of .30 and greater) onto more than one trait domain. Although this is not uncommon, particularly in personality research, the cleanest or simplest factor structure possible is still desired. Therefore, it is preferable for facets to have loadings of at least .30 onto their primary domain and demonstrate no or few cross-loadings

on other domains (Costello & Osborne, 2005). Ideally, each facet would have only one significant or primary loading (Floyd & Widaman, 1995). The facets restricted affectivity, hostility, perseveration, depressivity, suspiciousness, callousness, rigid perfectionism and risk taking did not clean-load, at times significantly loading onto three (depressivity) and even four (rigid perfectionism) domains. All trait facets did load most highly onto their primary domain, although at times by slim margins. The trait facet submissiveness narrowly failed to load significantly onto the negative affectivity domain.

Wright et al. (2012) aimed to replicate the five-factor structure of the PID-5 in an independent sample of 2,461 undergraduate students. EFA of the 25 facet scales suggested four-, five- and six-factor solutions. However, the five-factor solution was the most interpretable and therefore retained. The facet scales depressivity, perseveration, restricted affectivity, and risk-taking significantly (.40 loading or greater) cross-loaded onto two domains. Depressivity primarily loaded onto detachment but demonstrated a significant cross-loading on disinhibition, mirroring Krueger et al. (2012). Risk taking's primary loading was on disinhibition, the domain proposed by Krueger et al. (2012), but its secondary loading was on detachment, unlike Krueger et al. where risk taking's secondary loading was on psychoticism. In contrast to Krueger et al. (2012), the restricted affectivity facet loaded primarily onto the detachment domain and secondarily onto negative affectivity. Perseveration also did not primarily load onto its proposed domain (negative affectivity) but instead onto psychoticism. Finally, the trait facets suspiciousness and submissiveness failed to load significantly onto any domain, but their highest loadings (on detachment and negative affect, respectively) adhered to Krueger et al. (2012)'s proposal. As an index of replicability of the factor structure proposed by Krueger et al. (2012), Wright et al. (2012) computed

factor congruency coefficients which ranged from .76 for psychoticism to .99 for antagonism, demonstrating poor to nearly identical degrees of factor similarity between the studies.

To our knowledge, three studies have examined the factor structure of the English-version PID-5 in a clinical or hybrid sample. Maples et al. (2015) conducted EFA in a hybrid sample of 1,417 community adults recruited via Amazon's Mechanical Turk (Mturk) website and undergraduate student populations and 109 adults receiving psychological or psychiatric treatment recruited via community advertisement. Although two to five factors could be extracted, the five-factor solution was retained and reported. The authors did not report a threshold used to determine meaningful factor loadings. However, using a widely accepted cut-off (.32, Tabachnick & Fidell, 2007), seventeen facets appear to significantly cross-load onto two or more domains. These facets are fully listed in Table 2. The cross-loading facets which did not demonstrate clean loadings include hostility, perseveration, depressivity, suspiciousness, eccentricity, callousness, distractibility and rigid perfectionism. Neither hostility nor restricted affectivity loaded onto their primary domain proposed by Krueger et al. (2012) (negative affectivity) but instead onto antagonism and detachment, respectively. Rigid perfectionism also did not demonstrate a proposed primary loading onto disinhibition but instead loaded onto psychoticism, a pattern not seen in the original validation study.

Creswell, Bachrach, Wright, Pinto, and Ansell (2016) examined the factor structure of the PID-5 in a sample of 877 adults, 39% of whom reported they were currently receiving mental health treatment. Five factors were extracted through EFA using maximum likelihood estimation and rotated using oblique Equamax rotation. The trait facets anhedonia and hostility significantly cross-loaded and were not "clean". Anhedonia loaded primarily onto

the detachment domain, in line with prior work (Krueger et al., 2012; Maples et al., 2015; Wright et al., 2012), and loaded secondarily onto the negative affectivity domain. Similar to Wright et al. (2012) and Maples et al. (2015), hostility loaded primarily onto the antagonism domain, in contrast to the original proposal suggesting a primary loading on negative affectivity (Krueger et al., 2012). Depressivity and rigid perfectionism loaded primarily onto negative affectivity, despite suggested primary loadings onto detachment and disinhibition, respectively. Similar to Wright et al. (2012), submissiveness and suspiciousness failed to load substantially onto any factor. Finally, factor congruency coefficients were reported for both Krueger et al. (2012) and Wright et al. (2012)'s factor solutions, with a range of .89-.96 and .92-.97, respectively. Antagonism demonstrated the greatest factor similarity across studies, whereas disinhibition and negative affectivity demonstrated the lowest. However, factor congruencies overall were high.

Shortly after publication of the PID-5, Quilty, Ayearst, Chmielewski, Pollock, and Bagby (2013) examined the unitary factor structure of each facet and domain using item-level data in a sample of 201 outpatients. Utilizing EFA, Quilty et al. (2013) suggested a one-factor solution for all domains and for all facets except risk-taking, depressivity and hostility. However, factor loadings and fit statistics for the overall model were not reported.

Independent factor analytic studies of translations of the PID-5

Since its publication in 2013, the PID-5 has been translated into at least eight languages, including Arabic (Al-Attayah, Megreya, Alrashidi, Dominguez-Lara, & Al-Sheerawi, 2017), Danish (Bo, Bach, Mortensen, & Simonsen, 2016), Dutch (De Fruyt et al., 2013), French (Roskam et al., 2015), German (Zimmermann et al., 2014), Italian (Fossati, Krueger, Markon, Borroni, & Maffei, 2013), Norwegian (Thimm, Jordan, & Bach, 2017),

Spanish (Gutierrez et al., 2017), Persian (Lotfi, Bach, Amini, & Simonsen, 2018) and Portuguese (Pires, Sousa Ferreira, & Guedes, 2017). To our knowledge, fifteen studies have examined the factor structure of these translated forms of the PID-5. Most conducted EFA (Bo et al., 2016; De Clercq et al., 2014; De Fruyt et al., 2013; Gutierrez et al., 2017; Roskam et al., 2015; Thimm et al., 2017; Van den Broeck et al., 2014; Zimmermann et al., 2014) or confirmatory factor analysis (CFA; (Al-Attayah et al., 2017; Bastiaens, Claes, et al., 2016; Bastiaens, Smits, et al., 2016; Fossati et al., 2013; Somma et al., 2017; Zimmermann et al., 2014) while five conducted exploratory structural equation modeling (ESEM; Bach et al., 2017; Bastiaens, Claes, et al., 2016; Bastiaens, Smits, et al., 2016; Lotfi et al., 2018; Somma et al., 2017).

The aforementioned studies appear to support the unidimensional structure of most facet scales. However, risk taking (Bastiaens, Smits, et al., 2016; Fossati et al., 2013; Somma et al., 2017) emotional lability (Bastiaens, Claes, et al., 2016; Gutierrez et al., 2017; Somma et al., 2017; Zimmermann et al., 2014) hostility (Bastiaens, Claes, et al., 2016; Somma et al., 2017; Zimmermann et al., 2014), perseveration (Zimmermann et al., 2014), manipulativeness (Somma et al., 2017; Zimmermann et al., 2014), depressivity, callousness and perceptual dysregulation (Roskam et al., 2015), and eccentricity and intimacy avoidance (Somma et al., 2017) each demonstrated a two-factor structure. Additionally, Roskam et al. (2015) found that the trait domain negative affectivity also demonstrated a two-factor structure, distinguishing between the restricted affectivity facet and all other negative affectivity facets.

Similarly to studies examining the factor structure of the English version of the PID-5, nearly all facets significantly cross-loaded onto more than one domain in at least one study. In particular, the facets anhedonia, attention seeking, callousness, deceitfulness,

depressivity, distractibility, eccentricity, emotional lability, hostility, impulsivity, irresponsibility, perceptual dysregulation, perseveration, restricted affectivity, rigid perfectionism, risk taking, suspiciousness and submissiveness demonstrated cross-loadings which were not clean, in some studies. Of these facets, depressivity, hostility, perseveration, restricted affectivity, rigid perfectionism and risk taking in particular demonstrated primary loadings across studies which did not mirror the original study by Krueger et al. (2012) and/or the DSM-5 AMPD proposal. Finally, the facets depressivity, hostility, perseveration, submissiveness and suspiciousness at times failed to significantly load onto any factor in studies utilizing primarily community samples (Bo et al., 2016; Lotfi et al., 2018; Thimm et al., 2017; Van den Broeck et al., 2014). For in-depth details regarding the methodology and results of factor analytic studies of the PID-5 translations, see Table 2.

Joint factor analytic studies

A number of studies have conducted “joint” factor analysis using the PID-5. This entails conducting EFA, CFA or ESEM on the PID-5 and another measure of trait personality or psychopathology, such as the NEO-PI-R, the Five Factor Model Rating Form (FFMRF; Mullins-Sweatt, Jamerson, Samuel, Olson, & Widiger, 2006)) or the Personality Assessment Inventory (PAI; Morey, 1991)), simultaneously. These studies frequently aimed to examine the convergent validity of the PID-5 and other FFM measures of personality (Ashton, Lee, E., Hendrickse, & Born, 2012; De Fruyt et al., 2013; Gore & Widiger, 2013; Thomas et al., 2013; Van den Broeck et al., 2014; Wright & Simms, 2014) or to determine if an existing measure of normative or disordered personality could be used to capture elements of the PID-5 and the AMPD proposal (Anderson et al., 2013; Wright & Simms, 2014). Other authors utilized joint factor analysis to explore the relation between PID-5 personality traits and

measures of psychopathology (Hopwood et al., 2013) or alternative theoretical models of trait-based personality (Ashton et al., 2012). The explicit aim of Griffin and Samuel (2014) was to clarify the number of factors measured by the PID-5 and the facet-level assignment of traits to higher-order domains. This was also a primary goal of many of the independent factor analytic studies reviewed previously – to confirm and clarify the factor structure of the PID-5 domains and facets in order to contribute to the measures psychometric validity and reliability. However, it is important to note that facet loadings and cross-loading patterns in most joint factor analytic studies cannot be thoroughly interpreted in relation to the AMPD, given that the higher-order domains or factors which emerge in these analyses are often not the same as those proposed by Krueger et al. (2012) and the AMPD. For example, the factors or domains which emerge are generally a “mix” of maladaptive and normative personality or of general psychopathology.

Briefly however, joint factor analytic studies of the PID-5 have identified some similar concerns regarding facet loadings as independent factor analytic studies of the PID-5. For example, hostility, perseveration, submissiveness and suspiciousness failed to load substantially onto any factor in some studies (Anderson et al., 2013; Hopwood et al., 2013; Thomas et al., 2013). Further, attention seeking, depressivity, eccentricity, impulsivity, intimacy avoidance, irresponsibility, restricted affectivity and risk taking also did not demonstrate substantial factor loadings, at times. Similar to independent factor analytic studies of the PID-5, these failures to load were observed in studies utilizing undergraduate samples (Anderson et al., 2013; Hopwood et al., 2013; Thomas et al., 2013). Finally, a number of PID-5 facets substantially cross-loaded across multiple studies (for a full listing see Table 2). Specifically, the facets depressivity, distractibility, hostility, impulsivity,

irresponsibility, perceptual dysregulation, rigid perfectionism, risk taking and suspiciousness demonstrated primary loadings which were dissimilar to the initial PID-5 publication by Krueger et al. (2012) and/or the DSM-5 AMPD proposal in that they did not load onto the “analogous” or expected factor that emerged in analysis.

In sum, joint factor analysis of the PID-5 with measures of trait-based personality, PDs or psychopathology may be useful for determining the construct validity of the PID-5 as well as the utility of existing measures in capturing maladaptive personality traits defined by the AMPD. However, if a secondary application of the results is to clarify the latent structure of the PID-5, there are methodological concerns unique to joint factor analysis which can obscure conclusions. For example, a greater variety of PID-5 facets fail to load or have non-primary domain loadings in joint factor analytic studies of the PID-5 than in independent studies and at times the psychoticism domain does not emerge at all. This is not necessarily an indication of discrepancies in the latent structure of the PID-5 but of the impact that variables from the other measure have on the apparent structure in FA. Additionally, with more than one measure being analyzed, analysis may be conducted at the domain-level rather than facet-level (due to concerns about sample size or complexity of the analysis) which does not clarify loading patterns of the PID-5 items or facets. Therefore, determining the PID-5’s structural validity and reliability as well as clarifying the measures item-facet-domain assignments must be determined through independent factor analysis.

Summary

The trait facets depressivity, hostility, perseveration, restricted affectivity, rigid perfectionism, submissiveness and suspiciousness appear to be particularly problematic in the factor structure of all translations of the PID-5, demonstrating significant and discrepant

cross-loadings or lack of loadings on domain factors proposed by Krueger et al. (2012) and/or the AMPD. An even greater variety of PID-5 facets appear to significantly cross-load, load onto non-primary domains or fail to load in factor analytic studies of PID-5 *translations*. This may be a result of cultural differences, translation differences, sample influences (i.e. among high school students) or the fact that there are three times as many independent factor analytic studies of the PID-5 translations than of the English PID-5. Other trait facets such as attention seeking, emotional lability, grandiosity, impulsivity, intimacy avoidance, manipulateness, separation insecurity, unusual beliefs and experiences and withdrawal appear to load “purely” onto their respective domains, across translations of the PID-5. Potentially, a number of facets including risk-taking (Bastiaens, Smits, et al., 2016; Fossati et al., 2013; Quilty et al., 2013; Somma et al., 2017), depressivity (Quilty et al., 2013; Roskam et al., 2015) and hostility (Bastiaens, Claes, et al., 2016; Quilty et al., 2013; Zimmermann et al., 2014) may be composed of more than one latent factor, contributing to their substantial domain cross-loadings observed in other studies. Only two studies (Quilty et al., 2013; Roskam et al., 2015), have examined the structure of the PID-5 trait domains individually and results appear to support a unidimensional factor structure for all domains, except negative affectivity (Roskam et al., 2015) which may have a two-factor structure. Congruency coefficients comparing factor similarity across studies suggest antagonism, detachment, and psychoticism may be the most stable domains whereas the negative affectivity and disinhibition domains may be less so. For all methodological details regarding the studies reviewed, see Table 2.

These findings have important implications for the utility of the AMPD and the PID-5. For example, the trait facets demonstrating the most inconsistent loading patterns or the

least discrimination between primary and secondary domains are currently not included in the APA scoring algorithm for the PID-5 (depressivity, hostility, perseveration, restricted affectivity, rigid perfectionism, submissiveness and suspiciousness). However, only four of these are cross-listed in the DSM AMPD text as “belonging” to more than one domain although rigid perfectionism and perseveration may also merit this consideration.

Additionally, an apparent “pure loading” facet, attention seeking, is not utilized in the current APA scoring algorithm domain for antagonism. This may be because the other three antagonism facets are also “pure loaders” and only three facets are required for scoring each domain. However, this seems arbitrary and calls into question the utility of scoring domains when facets provide greater detail about an individual’s personality traits. Secondly, given that not all facets and domains have consistently demonstrated a unidimensional factor structure, it is possible that scoring procedures should adjust accordingly to accommodate new facets or domains. However, if facets consistently fail to load, cross-load substantially or load inconsistently onto domain factors it may be questionable what the higher-order domain structure of the PID-5 “brings to the table” in the AMPD. With regards to the utility and scoring of the PID-5 it may be more appropriate to focus on the trait facets if the higher order structure is not clearly evident.

Limitations of literature examining the latent factor structure of the PID-5

Despite expressed support for the use of a maladaptive trait approach to personality pathology (Hopwood et al., 2018), limitations of prior study designs are contributing to the above discrepancies and inconsistencies regarding the PID-5 factor structure and important issues regarding the utility of the PID-5 and the AMPD moving forward.

1) The majority of studies aiming to replicate the factor structure of the PID-5 have utilized translations and not the English version. Although these studies provide valuable insight into the cross cultural utility of the PID-5, not all reported adequate translation procedures for direct comparison of results with studies of the English PID-5 (Al-Dajani, Gralnick, & Bagby, 2016). Additionally, even when best-practice translation procedures are used this does not ensure that the same constructs are being measured across cultures, only that the test content is the same (Al-Dajani et al., 2016). Therefore, factor analytic findings in these studies may be a result of cross-cultural variations in personality pathology or self-report tendencies and may not be generalizable to English speaking clinical populations. Therefore, factor analytic work using the English translation of the PID-5 remains necessary, particularly in clinical samples.

2) A second limitation of prior work concerns the methodology of the FA. The majority of factor analytic studies using the English PID-5 have conducted joint FA with other measures of the FFM, PDs or psychopathology. This work is a useful exploration of the PID-5's construct validity and its relation to other aspects of psychopathology. However, in general, joint-FA has not been used to explore the lower order structure of the PID-5 in detail and can actually obscure conclusions related to this issue, given that the other measure included in the analysis impacts facet loadings and the domains which emerge. Therefore, although joint-FA may be advantageous for exploring the PID-5's construct validity, it cannot illuminate the psychometric strength or replicability of the PID-5 in unique samples. Additionally, the widespread use of EFA and target rotation in independent factor analytic studies of the PID-5 has been noted as a methodological weakness of the literature (South & Jarnecke, 2017).

3) The independent factor analytic work that has been conducted on the PID-5 (using all translations) is also greatly limited in its ability to clarify the measures latent factor structure as the majority of analyses have been conducted on facet or domain-level scores and not item-level data (South & Jarnecke, 2017). This is problematic given that the PID-5's factor structure was initially examined (Krueger et al., 2012) using item-level data and is best replicated using similar methodology. Further, poor performing items or discrepancies in the lower-order factor structure of the measure are not observable when conducting factor analysis on facet level scores. As yet, factor analysis using item-level data from the 220-item PID-5 has only been attempted in one study using the English translation of the PID-5 (Quilty et al., 2013).

4) Some studies also suffer from a lack of clarity in reporting data analytic decisions. Authors are often unclear about what criteria were used to justify factor extraction, what factor rotation method was used and fail to report adequate information about factor solutions or justify why statistical decisions were made (South & Jarnecke, 2017). Best practices in FA and SEM highly recommend thorough reporting and justification of all methodology to ensure clarity of results and replicability of analyses (Floyd & Widaman, 1995; South & Jarnecke, 2017).

5) Finally, all but one of the independent factor-analytic studies using the English translation of the PID-5 (and half of the translation studies) have utilized EFA. Although the use of CFA in personality research has been met with caution given the complexity of models of personality (Hopwood & Donnellan, 2010), it is more appropriate to utilize confirmatory factor analytic approaches when strong pre-conceptions regarding the structure of a measure are present (Russell, 2016). Recommendations for the appropriate use of CFA

in personality research have been made. These including utilizing multiple factor analytic techniques, interpreting misfit of the measure structure in the context of prior research and keeping the practical and conceptual implications of decisions in mind when attempting to achieve the best model fit (Hopwood & Donnellan, 2010). In light of all the methodological options available in factor analysis, it is important for continued research to employ a variety of techniques when considering the factor structure of the PID-5 forms.

The current study

Aims

Against this background, the aim of the current study was to clarify the latent factor structure of the 220-item English PID-5 using hierarchical CFA in a diverse, undergraduate student sample. In particular, the aims were to:

- 1) *Aim 1.* Examine the unidimensional structure of each PID-5 facet individually with particular attention paid to facets which may demonstrate issues with item keying and two-factor structures.
 - a. Facets which demonstrated less than ideal model fit based on best practice fit statistic interpretation would be modified to achieve acceptable or good model fit.
- 2) *Aim 2.* Examine the unidimensional structure of each PID-5 domain individually with particular attention paid to domains which have demonstrated the least stability in prior research.
 - a. Domains which demonstrated poor model fit would be modified by adding in the facet-level modifications made in aim 1.

- b. Domains which continued to demonstrate poor model fit would be further modified to achieve acceptable model fit.
- 3) *Aim 3*. Examine model fit of the entire, hierarchical PID-5 structure (Figure 2) with and without facet and domain level modifications, using item-level data.

Hypotheses

With regards to the above aims, we hypothesized that:

- 1) *Aim 1 Hypothesis*. The majority of facets would demonstrate acceptable, unidimensional model fit as observed in prior studies utilizing CFA. Facets which have demonstrated the potential for two-factor structures in prior research (i.e. risk taking, hostility) would not demonstrate acceptable, unidimensional model fit and would require modification.
- 2) *Aim 2 Hypothesis*. The majority of domains would not demonstrate acceptable model fit. The addition of modifications made in aim 1 would improve model fit. Further modifications to each domain model may be necessary to achieve acceptable model fit.
- 3) *Aim 3 Hypothesis*. The model fit of the entire PID-5 structure without modifications would not achieve acceptable model fit. The addition of modifications made in aim 1 and aim 2 would improve model fit.

Methods

Participants

Participants were recruited from the undergraduate student population of a large, public university in the southern United States. 1,262 subjects completed study measures online as part of a larger study examining personality norms in college students. Inclusion

criteria for participation required that subjects 1) be between the ages of 18 and 25, 2) be currently enrolled as an undergraduate student and 3) have at least partially completed the PID-5. Subjects were excluded from data analysis in the current study if 1) they were not between the ages of 18 and 25, 2) their response was identified as a duplicate, 3) they had consented to participate but did not begin the study or at least partially complete the PID-5 or 4) their data quality was deemed insufficient as determined by their responses to a number of “check questions”. Check questions were ten Likert scale items dispersed randomly throughout the survey which requested that participants select a certain response for that item (i.e. “Please select “I agree” for this question”). Correct responses were coded “0” and incorrect responses were coded “1”. These ten check questions were then totaled for each participant. Any participant with a total check question score greater than one was excluded from data analysis. After all exclusions were implemented for age ($n = 52$) duplicate responses ($n = 29$), data quality ($n = 143$) and lack of data ($n = 55$), the final sample consisted of 983 subjects.

Of the final sample, 77.4% ($n = 761$) were female, 22% ($n = 216$) were male and .6% ($n = 6$) identified as a gender minority. The sample was on average 20.32 years old ($SD = 1.83$). The racial/ethnic breakdown of the sample was as follows: 39.3% Caucasian, 28.6% Asian, 13.7% mixed race or other, 9.7% Black or African American, 5.8% Hispanic/Latino or Mexican American, 1.8% Native American or Alaskan Native and 1.1% unidentified. 371 participants (37.7% of the sample) identified as being Hispanic or Latino. The median annual household income reported by participants was between \$70,000 and \$79,000 and the majority of participants reported their fathers (79.5%) and mothers (81.5%) had at least a high school degree. Finally, 27.1% of the sample had sought treatment for emotional or

mental health concerns in the past and 7.2% and 6.1% of subjects were currently in treatment or on medication for emotional or mental health problems, respectively. According to the McLean Screening Instrument for BPD (MSI-BPD; Zanarini et al., 2003), 22.6% of the sample screened positive for BPD.

Measures

Personality Inventory for DSM-5 (PID-5; Krueger et al., 2012). The PID-5 is a 220-item self-report measure of trait-based personality pathology constructed to capture criterion B of the AMPD in DSM-5. It is purported to contain twenty-five, lower-order personality trait facets organized under five, higher-order personality trait domains. Each item is rated on a scale of 0 (very false or often false) to 3 (very true or often true). Trait facets are composed of four to fourteen items and facet scores are calculated by reverse-scoring indicated items and then averaging all items. Trait domains are composed of three facets and domain scores are calculated by averaging all three facets. Therefore, all items are utilized in calculating facet scores but not all facet scores are utilized in calculating domain scores. The AMPD outlines which trait facets should be elevated in order to specify a PD diagnosis as antisocial, avoidant, borderline, narcissistic, obsessive-compulsive or schizotypal. In the current study for descriptive statistical analyses, facet and domain scores were calculated using the official APA scoring algorithm described above. However, in all domain and hierarchical FA, *all* facets were analyzed according to their primary domain assignment in the AMPD descriptive text.

Procedures

Data collection was approved by the University of Houston Committee for the Protection of Human Subjects and occurred as part of a larger study examining personality norms in

college students. Participants were not actively recruited, rather the study was advertised on the UH SONA website. There, undergraduate students signed-up to participate, consented to research and completed all study measures online. All responses were anonymous and identifiable only by a randomly generated code. Upon completion of the study, participants received college course extra credit.

Data Analytic Strategy

Preliminary analyses. Preliminary data analysis was conducted in *IBM SPSS 25*. PID-5 facet and domain scores for each subject were calculated using the scoring algorithm published by the APA in section III of the DSM-5. The internal consistency of each facet and domain was determined using Cronbach's alpha. Sample means, standard deviations and skewness and kurtosis for each facet and domain were also calculated. Although CFA and EFA are generally robust to violations of distributional normality (Floyd & Widaman, 1995), it remains ideal for each variable to possess approximate normality in any given sample. Given that PID-5 items are rated on a short Likert scale which are not always conceptualized as continuous, the distributional normality of each PID-5 item was also assessed using skewness and kurtosis statistics.

Aim 1: clarify the latent factor structure of the PID-5 facets. All CFA was completed in *MPlus 8.0* using robust full information maximum likelihood (FIML) estimation. To accomplish aim 1 of the current study, CFA was conducted on each facet of the PID-5 individually. The adequacy of the fit of each model was determined using multiple model fit statistics including: the chi-square statistic, the comparative fit index (CFI; Bentler, 1990), the Tucker-Lewis Index (TLI; Tucker & Lewis, 1973), the root-mean-square error of approximation (RMSEA; Cole & Maxwell, 2003) and the Standardized Root Mean Square

Residual (SRMR). Recommended values on both the CFI and TLI statistics to achieve good and acceptable fit are greater than or equal to .95 and .90, respectively (Hu & Bentler, 1999). Recommended values for the RMSEA to achieve good and acceptable fit are less than or equal to .05 and .06, respectively (Hu & Bentler, 1999). Recommended values for the SRMR to achieve good and acceptable fit are less than or equal to .05 and .08, respectively (Diamantopoulos & Siguaaw, 2013; Hu and Bentler, 1999). In the current study, models were deemed as having achieved good or acceptable model fit if 3 of 5 fit statistics thresholds were met. Facets which did not initially achieve good, unidimensional model fit were adjusted using modification indices to improve fit. Modification indices were utilized with the proposed PID-5 structure, prior research and theory in mind. Once good model fit was achieved for the facet, a chi-square test was conducted to determine the effect size of the improvement in model fit. The significance of the improvement in model fit was not evaluated given that the large sample size would likely render any improvement in fit statistically significant. Effect sizes were evaluated using Cohen's w where values of .1, .3 and .5 indicate small, medium and large improvements in model fit, respectively.

Aim 2: clarify the latent factor structure of the PID-5 domains. To accomplish aim 2 of the current study, CFA was conducted on each domain of the PID-5 individually, continuing to model item-level data. The adequacy of the fit of each model was determined using the fit statistics and cut-off determinations outlined in aim 1. Domains which did not initially achieve acceptable model fit were adjusted by adding in the facet-level modifications made in aim 1. Chi-square tests were conducted to determine the effect size of the improvement in model fit. If model fit was still not acceptable, modification indices were

used to improve fit. Once acceptable model fit was achieved for each domain, chi-square tests were conducted again to determine the effect size of the improvement in model fit.

Aim 3: clarify the hierarchical latent factor structure of the PID-5. To accomplish aim 3 of the current study, CFA was conducted to examine the entire hierarchical structure of the PID-5. The hierarchical model of the PID-5 was tested in order to examine whether the facets and domains can be thought of as maintaining their uni-dimensional structure in the context of all other scales of the measure. Inadequate fit of the hierarchical model may imply that the proposed organization of items to facet and facets to domains does not adequately capture the data, in spite of the apparent uni-dimensionality of the scales independently. In other words, there may be alternative, superior hierarchical structures which organizes the data. The adequacy of the proposed model was determined using the fit statistics thresholds outlined in aim 1. If acceptable model fit was not achieved, the facet and domain level modifications made in aim 1 and 2 would be added to the model. Chi-square tests would be conducted to determine the effect size of the improvement in model fit.

Results

Preliminary results

Descriptive statistics for facets and domains of the PID-5 are reported in Table 3. Internal consistency of the facets ranged from questionable ($\alpha = .63$) to excellent ($\alpha = .95$), with a median Cronbach's alpha of .86. Only the suspiciousness facet scale demonstrated questionable internal consistency. Internal consistency of the domains ranged from acceptable ($\alpha = .72$) to good ($\alpha = .89$), with a median Cronbach's alpha of .86. The skewness and kurtosis of all facet and domain scales, except for the facet scale callousness, was within normal limits (± 2). The skewness and kurtosis of the majority of PID-5 items ($n = 204$) was

also within normal limits. Items 11, 19, and 198 of the callousness scale and item 178 of the depressivity subscale demonstrated positive skew and kurtosis. Items 2, 13, 44, 54, 57, 72, 119, 143, 153, 166, 171 and 192 demonstrated only positive kurtosis. These items make up portions of the callousness, depressivity, irresponsibility, perceptual dysregulation, separation insecurity, suspiciousness and unusual beliefs and experiences scales.

Aim 1: results of CFA's of the PID-5 facets.

Results of item-level CFA's of the PID-5 facet scales are reported in Tables 3 and 4. Specifically, a summary of the standardized factor loadings of PID-5 items onto each facet scale in initial CFA models is presented in Table 3. Model fit statistics for the initial facet models and subsequently modified models are reported in Table 4. The majority of items ($N = 209$) demonstrated large standardized loadings on their respective facets, with median loadings for each facet ranging from .54 to .59. However, in their respective models, item 96 from the anxiousness facet, item 90 from the callousness facet, item 142 from the deceitfulness facet, 6 items from the risk-taking facet and item 131 and 177 from the suspiciousness facet had standardized factor loadings lower than .32. Each of these items is a reverse-scored item.

The attention seeking, callousness, distractibility, eccentricity, impulsivity, intimacy avoidance, irresponsibility, perseveration, and submissiveness facet scales appeared to be unidimensional, demonstrating good model fit on at least 3 out of 5 fit statistics. The anhedonia, anxiousness, deceitfulness, depressivity, emotional lability, grandiosity, hostility, manipulativeness, perceptual dysregulation, restricted affectivity, rigid perfectionism, separation insecurity, suspiciousness, unusual beliefs and experiences and withdrawal facet scales demonstrated generally acceptable but not good unidimensional model fit. Using

modification indices, residual covariance between items were specified in order to improve model fit. Facets on average required only 2 modifications to achieve good model fit (range: 1-5), with only depressivity requiring the most (5) modifications. Modifications improved model fit for each facet and the effect size of this improvement was small to medium ($w_{\text{avg}} = .28$; range = .15-.35).

The risk-taking facet scale demonstrated exceptionally poor model fit ($X^2 = 1667.08$; RMSEA = .15; CFI = .58; TLI = .51; SRMR = .15). Examination of the modification indices for this scale revealed that substantial covariance existed between items 7, 35, 87, 98, 164 and 215 in particular. In scoring the PID-5, each of these items is reverse scored prior to being averaged as part of the risk-taking facet. This suggests that the scale may diverge between items which are reverse scored and those that are not. A follow-up CFA model was conducted examining a two-factor structure for the risk-taking facet. Factor 1 consisted of the aforementioned reverse scored items (7, 35, 87, 98, 164 and 215) and factor 2 consisted of the remaining risk-taking items (3, 39, 48, 67, 69, 112, 159 and 195). This structure demonstrated nearly acceptable model fit ($X^2 = 420.16$; RMSEA = .07; CFI = .91; TLI = .89; SRMR = .06) and the effect size of this improvement in fit from the original model was large ($w = 1.13$).

Aim 2: results of CFA's of the PID-5 domains.

Results of hierarchical, item-level CFA's of the PID-5 domain scales are reported in Tables 3, and 5-10. Specifically, a summary of the standardized factor loadings of the PID-5 facets onto each domain scale are presented in Table 3. Model fit statistics for the initial domain models and the subsequent modified models are reported in Table 5. Tables 6-10 contain the standardized factor loadings of the items onto facets and facets onto domain for

the initial, unmodified antagonism, detachment, disinhibition, negative affectivity, and psychoticism domain models, respectively.

As summarized in Table 3, all facets demonstrated large standardized factor loadings on their respective domains, with median loadings for each domain ranging from .77-.95. However, at the item level, all items which failed to load substantially in their respective facet models in aim 1 continued to fail to load substantially onto their facet factor in their respective domain model. In addition, two reverse-scored items, item 30 from the anhedonia subscale and item 210 from the irresponsibility subscale, also failed to load substantially onto their facet factor in the detachment and disinhibition domain models, respectively.

As reported in Table 5, only the psychoticism domain scale initially achieved acceptable unidimensional model fit. Adding the modifications made to facet scales in aim 1 to the domain models improved model fit for each domain such that the antagonism, detachment and negative affectivity domains achieved acceptable model fit. The effect size of this improvement across the 5 domains was small to large ($w_{median} = .20$; range = .18 – 1.13). Using modification indices, residual covariance's between items and facets were specified for the disinhibition domain model in order to improve fit. Specifically, the disinhibition domain model required the specification of residual covariance between factor 1 of the risk-taking facet (reverse scored items) and two other facets. Two residual covariance's between items were also specified. The effect size of the models improvement in fit was medium ($w = .35$).

Aim 3: results of CFA of the hierarchical PID-5 structure.

Results of item-level CFA of the hierarchical item, facet and domain structure of the PID-5 are reported in Table 5 and 11. Specifically, model fit statistics for the initial,

unmodified model and the subsequent modified models are reported in Table 5. Table 11 contains the standardized factor loadings of the facets onto their domains and covariance's between each of the domains for the initial, unmodified hierarchical model.

As reported in Table 11, in the hierarchical model of the PID-5 containing all items, all facets and all domains, all facets demonstrated large standardized factor loadings on their respective domains, with loadings ranging from .52-.99. Covariance between domain factors in the hierarchical model was high and ranged from .62-.88. As reported in Table 5, the PID-5 hierarchical trait model did not initially achieve acceptable model fit. Adding the modifications made to facet scales in aim 1 to the model improved model fit and the effect size of this improvement was medium ($w = .32$). Subsequently adding the modifications made to the domain scales in aim 2 to the model improved model fit again and the effect size of this improvement was also medium ($w = .31$). Modifications were not made to the model to further improve model fit, given the complexity of the model and the number of modifications which would be required to achieve “acceptable” model fit.

Discussion

The PID-5 is a measure of maladaptive personality traits published by the APA in DSM-5 to assess for criterion B of the AMPD. The items of the PID-5 are organized under 25 trait facet scales, which are then organized under 5 second-order trait domain scales. Since the measures publication, a number of studies have evaluated this factor structure using a wide range of factor analytic procedures. However, no studies have conducted item-level CFA on the English translation of the measure and only one has conducted item-level EFA. CFA may be a more appropriate factor analytic approach to evaluate measures where strong pre-conceptions regarding the structure are present (Russell, 2016) and the PID-5's factor

structure was initially examined (Krueger et al., 2012) using item-level data so may be best replicated using similar methodology. Further, poor performing items or discrepancies in the lower-order factor structure of the measure are not observable when conducting factor analysis on facet level scores. Therefore, the aim of the current study was to clarify the latent factor structure of the 220-item English PID-5 using hierarchical CFA in a diverse, undergraduate student sample.

In line with hypothesis 1, CFA suggested that the majority (24 out of 25) of facets demonstrated acceptable model fit and 9 out of 25 initially achieved good unidimensional model fit. Further, 15 out of the remaining 16 facets achieved good unidimensional model fit with modification. Modifications to specify residual covariance between items generally included items with: 1) similar wording (i.e. deceitfulness item 53 (“I often *make up* things about myself to help me get what I want.”) and item 41 (“I *make up* stories about things that happened that are totally untrue.”)), 2) redundancy (i.e. withdrawal item 161 (“I don’t like to get too close to people.”) and item 10 (“I prefer not to get too close to people.”)), 3) markedly similar or extreme themes (i.e. perceptual dysregulation item 192 (“Sometimes I think someone else is removing thoughts from my head.”) and item 154 (“Sometimes I feel “controlled” by thoughts that belong to someone else.”)) or 4) reverse scoring (i.e. suspiciousness item 177 (“I rarely feel that people I know are trying to take advantage of me.”) and item 131 (“People are basically trustworthy.”)). In contrast to hypothesis 1, depressivity and hostility initially achieved acceptable model fit and were modified through the specification of 5 and 3 item covariance’s, respectively, to achieve good model fit. This result is in contrast to prior research which has frequently demonstrated two-factor structures for these facets (Quilty et al., 2013; Roskam et al., 2015; Zimmermann et al., 2014). In the

depressivity facet, items 81 (“The world would be better off if I were dead.”), 119 (“I talk about suicide a lot.”), 148 (“I’m useless as a person.”), 169 (“I have no worth as a person.”) and 178 (“I know I’ll commit suicide sooner or later.”) demonstrated patterns of shared variance not accounted for in the unidimensional model. Similar to modifications required by other facets, these items contained similar wording (suicide), redundancy (useless vs. no worth as a person) and similar or extreme themes (death or suicide). With regards to the hostility facet, modifications to specify residual covariance between items included markedly similar themes items 92 (“I have a very short temper.”) and (“I am easily angered.”). Finally, in line with hypothesis 1 and prior research (Bastiaens, Smits, et al., 2016; Fossati et al., 2013; Quilty et al., 2013; Somma et al., 2017) the risk-taking facet demonstrated exceptionally poor model fit. CFA of a two-factor structure where the reverse scored items of the risk-taking scale comprised one factor and the remaining items comprised another provided nearly acceptable fit to the data, indicating problems with item keying.

In line with hypothesis 2, CFA suggested that only the psychoticism domain scale of the PID-5 initially demonstrated acceptable model fit. However, also in line with hypotheses, the addition of modifications made to the facet scale models in aim 1 improved the model fit of all domain scales such that the antagonism, detachment, and negative affectivity domain scales achieved acceptable model fit. That negative affectivity achieved acceptable model fit post-modifications is somewhat surprising given that prior research has suggested a two-factor structure for the domain (Roskam et al., 2015) and factor congruency coefficients for negative affectivity across studies have largely been weaker than the other domains. However, support for the unidimensional structure of the negative affectivity domain in the current study is a result of the modifications made in aim 1 to the emotional lability,

separation insecurity, and hostility facet scales which may have provided sources of misfit for the domain in prior research. It is also possible that a two-factor structure does provide a superior or good fit to the negative affectivity domain, as the unidimensional structure did not achieve good model fit in the current study. Further modifications to the disinhibition domain model were necessary to achieve acceptable model fit. Residual covariance was specified between the “risk-taking 1” facet (the reverse scored or non-risk taking items) and the distractibility facet and the “risk-taking 1” facet and the rigid perfectionism facet. Additionally, residual covariance between items 210 (“I follow through on commitments.”) and 58 (“I usually think before I act.”) and 112 (“I don’t mind a little risk now and then.”) and 67 (“I like to take risks”) were specified. That the disinhibition domain did not initially achieve acceptable model fit is not surprising given the exceptionally poor fit of the risk-taking facet in aim 1 of the current study, and observations in prior research that the disinhibition domain is one of the most inconsistent across studies. Finally, as hypothesized the hierarchical model of the PID-5 did not achieve acceptable model fit but additions of the modifications made in aim 1 and 2 of the current study improved model fit. Given the very large nature of the PID-5 model using item-level analyses, it was not hypothesized that acceptable model fit would be achievable.

In all, the majority of facet scales in the PID-5 appear to be unidimensional. The majority of items demonstrate large factor loadings onto their respective facets. However, all reverse scored items consistently demonstrated lack of substantial loading and are likely sources of model misfit for the facet scales. Model fit and consistency of loading patterns in future factor analytic studies of these scales may be improved by shortening of the measure to remove redundant or highly repetitive items and those that are reverse scored. In a prior

item-response theory study of the PID-5, an attempt to shorten the measure ultimately removed problematic items observed in the current study, for example on the deceitfulness and depressivity scale (Maples, et al., 2015). Maples and colleagues also reduced the risk-taking facet substantially from 14 items to 4 and only included items which were not reverse scored and where higher scores indicate pathology.

Although the psychoticism domain initially achieved acceptable model fit in the current study and 3 out of the 5 remaining domains of the PID-5 achieved acceptable model fit after addition of model specifications made to facet scales in aim 1, it is of note that no domain scales achieved good model fit in the current study. This is in spite of the fact that substantial factor loadings were observed for all facets onto their respective domains. This suggests that the facet scales do not “hang together” under each domain as strongly as one would expect if they constituted a uni-dimensional higher-order construct. This point is well illustrated by examining some large discrepancies between factor loadings of the facets in each domain model. For example, it is problematic that some facets load so substantially (i.e. impulsivity loading .95 onto disinhibition), while others load relatively weakly (i.e. rigid perfectionism loading .39 onto disinhibition) onto their assigned domain. This calls into question the relative utility of higher-order domain factors in conceptualizing and assessing for personality pathology when the facet scales specify more concrete personality traits and ultimately are the constructs utilized to determine PD diagnoses in the AMPD.

Finally, although modifications to facet and domain scales improved model fit of the entire hierarchical model of the PID-5, acceptable model fit was not achieved. Although good model fit may have been unlikely given the number of parameters in the model, model fit was poor despite good model fit of all facets, acceptable model fit of all domains and

substantial loadings of all facets onto their respective domains. This suggests that the proposed organization of the measure (i.e. items to facet scales and facet scales to domain scales in the context of all other items and scales) may not be: 1) necessary or 2) the best model to capture the item-level data. To elaborate, if strong internal consistency and loading patterns for the facet scales is observed, higher-order organization under domain scales may be unnecessary. Alternatively, it may be that alternative hierarchical models of the measure which find 2-4 domain level factors may be superior to the proposed 5-factor structure.

Limitations and future directions

Despite its contribution to the assessment of the latent factor structure of the PID-5, the current study has a number of limitations. Firstly, the study is limited in its use of an undergraduate sample. Although the majority of items and scales approximated a normal distribution, suggesting that the data captured a range of normative and maladaptive responses, the current study was unable to evaluate the factor structure of the measure in a clinical sample which would consist of a higher frequency of pathological responses. Future studies should replicate item-level CFA of the PID-5 in clinical samples. Secondly, although the sample was racially and ethnically diverse and consisted of individuals from a number of socioeconomic and gender and sexual orientation groups, it was predominantly female which may have impacted the range and performance of facets and domains characterized by externalizing psychopathology, for example the disinhibition domain.

A third limitation of the current study is its use of online data collection. In spite of “check questions” which aimed to reduce the amount of random responding present in the sample, it is possible that some participants may have been able to locate and accurately respond to check questions and still respond somewhat randomly or inconsistently to other

items. However, the strictness of the current studies inclusion and exclusion criteria should have reduced the prevalence of this occurrence.

In spite of these limitations, the current study makes significant contributions to the study of pathological personality traits defined in the AMPD. Results of the current study suggest that the majority of facet scales on the PID-5 demonstrate good internal consistency and have a unidimensional factor structure. Although domain scales of the PID-5 may reach acceptable levels of internal consistency and uni-dimensionality, the incremental utility of the domain scales over the facet scales in conceptualizing and assessing for the presence of personality pathology remains in question. Further, the hierarchical structure of the PID-5 using item-level factor analytic techniques requires further investigation to compare alternative second-order models to the structure proposed in the AMPD of the DSM-5.

References

- Al-Attayah, A. A., Megreya, A. M., Alrashidi, M., Dominguez-Lara, S. A., & Al-Sheerawi, A. (2017). The psychometric properties of an Arabic version of the Personality Inventory for DSM-5 (PID-5) across three Arabic-speaking Middle Eastern countries. *International Journal of Culture and Mental Health*, 10(2), 197-205.
doi:10.1080/17542863.2017.1290125
- Al-Dajani, N., Gralnick, T. M., & Bagby, R. M. (2016). A Psychometric Review of the Personality Inventory for DSM-5 (PID-5): Current Status and Future Directions. *Journal of Personality Assess*, 98(1), 62-81. doi:10.1080/00223891.2015.1107572
- Anderson, J. L., Sellbom, M., Bagby, R. M., Quilty, L. C., Veltri, C. O., Markon, K. E., & Krueger, R. F. (2013). On the convergence between PSY-5 domains and PID-5 domains and facets: implications for assessment of DSM-5 personality traits. *Assessment*, 20(3), 286-294. doi:10.1177/1073191112471141
- Ashton, M. C., Lee, K., E., d. V. R., Hendrickse, J., & Born, M. P. (2012). The maladaptive personality traits of the Personality Inventory for DSM-5 (PID-5) in relation to the HEXACO personality factors and schizotypy/dissociation *Journal of Personality Disorders*, 26(5), 641–659.
- American Psychiatric Association (1952). *Diagnostic and Statistical Manual of Mental Disorders*.
- American Psychiatric Association (1968). *Diagnostic and Statistical Manual of Mental Disorders: DSM-II*.
- American Psychiatric Association (1980). *Diagnostic and Statistical Manual of Mental Disorders (3rd ed.)*.

- American Psychiatric Association (1987). *Diagnostic and Statistical Manual of Mental Disorders; revised (DSM-III-R)*.
- American Psychiatric Association (1994). *Diagnostic and Statistical Manual of Mental Disorders (4th ed.)*.
- American Psychiatric Association (2000). *Diagnostic and Statistical Manual of Mental Disorders-IV-TR*.
- American Psychiatric Association (2013). *Diagnostic and Statistical Manual of Mental Disorders (DSM-5®)*.
- Bach, B., Sellbom, M., & Simonsen, E. (2017). Personality Inventory for DSM-5 (PID-5) in Clinical Versus Nonclinical Individuals: Generalizability of Psychometric Features. *Assessment*, 1073191117709070. doi:10.1177/1073191117709070
- Bastiaens, T., Claes, L., Smits, D., De Clercq, B., De Fruyt, F., Rossi, G., . . . De Hert, M. (2016). The Construct Validity of the Dutch Personality Inventory for DSM-5 Personality Disorders (PID-5) in a Clinical Sample. *Assessment*, 23(1), 42-51. doi:10.1177/1073191115575069
- Bastiaens, T., Smits, D., De Hert, M., Vanwalleghe, D., & Claes, L. (2016). DSM-5 section III personality traits and section II personality disorders in a Flemish community sample. *Psychiatry Research*, 238, 290-298. doi:10.1016/j.psychres.2016.02.056
- Block, J. (1995). A contrarian view of the five-factor approach to personality description. *Psychological Bulletin*, 117(2), 187-215.
- Bo, S., Bach, B., Mortensen, E. L., & Simonsen, E. (2016). Reliability and hierarchical structure of DSM-5 pathological traits in a Danish mixed sample. *Journal of Personality Disorders*, 30(1), 112–129.

- Cattell, R. B. (1946). *The Description and Measurement of Personality*. Yonkers, NY: World Book.
- Clark, L. A. (1993). *The schedule for nonadaptive and adaptive personality*. Minneapolis, MN: University of Minnesota Press.
- Clarkin, J. F., & Huprich, S. K. (2011). Do DSM-5 personality disorder proposals meet criteria for clinical utility? *Journal of Personality Disorders*, 25(2), 192-205.
- Coolidge, F. L., & Segal, D. L. (1998). Evolution of personality disorder diagnosis in the Diagnostic and Statistical Manual of Mental Disorders. *Clinical Psychology Review*, 18(5), 585-599.
- Costa Jr, P. T., & McCrae, R. R. (1992). *Revised NEO Personality Inventory NEO-PI-R and NEO Five-Factor Inventory NEO-FFI professional manual*. Odessa, FL: Psychological Assessment Resources.
- Costa Jr, P. T., & Widiger, T. A. (1994). *Personality disorders and the five-factor model of personality*. Washington, DC, US: American Psychological Association.
- Costa, P. T., & McCrae, R. R. (1992). Normal personality assessment in clinical practice: The NEO Personality Inventory. *Psychological Assessment*, 4(1).
- Costello, A. B., & Osborne, J. W. (2005). Best Practices in Exploratory Factor Analysis: Four Recommendations for Getting the Most From Your Analysis. *Practical Assessment, Research & Evaluation*, 10(7).
- Creswell, K. G., Bachrach, R. L., Wright, A. G., Pinto, A., & Ansell, E. (2016). Predicting problematic alcohol use with the DSM-5 alternative model of personality pathology. *Personality Disorders: Theory, Research, and Treatment*, 7(1), 103-111.
doi:10.1037/per0000131

- De Clercq, B., De Fruyt, F., De Bolle, M., Van Hiel, A., Markon, K. E., & Krueger, R. F. (2014). The hierarchical structure and construct validity of the PID-5 trait measure in adolescence. *Journal of Personality*, 82(2), 158-169. doi:10.1111/jopy.12042
- De Clercq, B., De Fruyt, F., Van Leeuwen, K., & Mervielde, I. (2006). The structure of maladaptive personality traits in childhood: A step toward an integrative developmental perspective for DSM-5. *Journal of Abnormal Psychology*, 115, 639-657.
- De Fruyt, F., De Clercq, B., De Bolle, M., Wille, B., Markon, K., & Krueger, R. F. (2013). General and maladaptive traits in a five-factor framework for DSM-5 in a university student sample. *Assessment*, 20(3), 295-307. doi:10.1177/1073191113475808
- Diamantopoulos, A., & Siguaw, J. A. (2013). *Introducing LISREL: A guide for the uninitiated*. Sage.
- Eysenck, H. J. (1947). *Dimensions of Personality*. New York: Praeger.
- First, M. B., Gibbon, M., Spitzer, R. L., & Williams, J. B. (2002). Structured clinical interview for DSM-IV Axis II personality disorders (SCID-II). Washington, D.C.: American Psychiatric Association
- Floyd, F. J., & Widaman, K. F. (1995). Factor analysis in the development and refinement of clinical assessment instruments. *Psychological Assessment*, 7(3), 286-299. doi:10.1037/1040-3590.7.3.286
- Fossati, A., Krueger, R. F., Markon, K. E., Borroni, S., & Maffei, C. (2013). Reliability and validity of the personality inventory for DSM-5 (PID-5): predicting DSM-IV personality disorders and psychopathy in community-dwelling Italian adults. *Assessment*, 20(6), 689-708. doi:10.1177/1073191113504984

- Goldberg, L. R. (1990). An alternative "description of personality": the big-five factor structure. *Journal of Personality and Social Psychology*, 59(6), 1216-1229.
- Gore, W. L., & Widiger, T. A. (2013). The DSM-5 dimensional trait model and five-factor models of general personality. *Journal of Abnormal Psychology*, 122(3), 816-821.
doi:10.1037/a0032822
- Griffin, S. A., & Samuel, D. B. (2014). A closer look at the lower-order structure of the Personality Inventory for DSM-5: comparison with the Five-Factor Model. *Personality Disorders: Theory, Research, and Treatment*, 5(4), 406-412.
doi:10.1037/per0000074
- Guilford, J. P. (1975). Factors and factors of personality. *Psychological Bulletin*, 82, 802-814.
- Gutierrez, F., Aluja, A., Peri, J. M., Calvo, N., Ferrer, M., Bailles, E., Gutiérrez-Zotes, J. A., Gárriz, M., Caseras, X., Markon, K. E., & Krueger, R. F. (2017). Psychometric Properties of the Spanish PID-5 in a Clinical and a Community Sample. *Assessment*, 24(3), 326-336. doi:10.1177/1073191115606518
- Harkness, A. R., McNulty, J. L., & Ben-Porath, Y. S. (1995). The personality psychopathology five (PSY-5): Constructs and MMPI-2 scales. *Psychological Assessment*, 7, 104-114.
- Herpertz, S. C., Huprich, S. K., Bohus, M., Chanen, A., Goodman, M., Mehlum, L., Moran, P., Newton-Howes, G., Scott, L., & Sharp, C. (2017). The Challenge of Transforming the Diagnostic System of Personality Disorders. *Journal of Personality Disorders*, 31(5).

- Hopwood, C. J., & Donnellan, M. B. (2010). How Should the Internal Structure of Personality Inventories be Evaluated? *Personality and School Psychology Review*, 14(3), 332-346.
- Hopwood, C. J., Kotov, R., Krueger, R. F., Watson, D., Widiger, T. A., Althoff, R. R., . . . Zimmermann, J. (2018). The time has come for dimensional personality disorder diagnosis. *Personality and Mental Health*, 12(1), 82-86. doi:10.1002/pmh.1408
- Hopwood, C. J., Wright, A. G., Krueger, R. F., Schade, N., Markon, K. E., & Morey, L. C. (2013). DSM-5 pathological personality traits and the personality assessment inventory. *Assessment*, 20(3), 269-285. doi:10.1177/1073191113486286
- Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: a Multidisciplinary Journal*, 6(1), 1-55.
- Jang, K. L., McCrae, R. R., Angleitner, A., Riemann, R., & Livesley, W. J. (1998). Heritability of facet-level traits in a cross-cultural twin sample: support for a hierarchical model of personality. *Journal of Personality and Social Psychology*, 74(6), 1556-1565.
- John, O. P., Donahue, E. M., & Kentle, R. L. (1991). The big five inventory—versions 4a and 54.
- Krueger, R. F., Derringer, J., Markon, K. E., Watson, D., & Skodol, A. E. (2012). Initial construction of a maladaptive personality trait model and inventory for DSM-5. *Psychological Medicine*, 42(9), 1879-1890. doi:10.1017/S0033291711002674

- Krueger, R. F., & Eaton, N. R. (2010). A personality trait model for the Diagnostic and Statistical Manual of Mental Disorders (DSM): the challenges ahead. *Personality Disorders: Theory, Research, and Treatment*, 1(2), 135-137. doi:10.1037/a0020071
- Krueger, R. F., Eaton, N. R., Clark, L. A., Watson, D., Markon, K. E., Derringer, J., Skodol, A., & Livesley, W. J. (2011). Deriving an empirical structure of personality pathology for DSM-5. *Journal of Personality Disorders*, 25(2), 170–191.
- Livesley, W. J., & Jackson, D. J. (2009). *Manual for the dimensional assessment of personality pathology*. Port Huron: Sigma Press.
- Loehlin, J. C., McCrae, R. R., Costa Jr, P. T., & John, O. P. (1998). Heritabilities of common and measure-specific components of the Big Five personality factors. *Journal of Research in Personality*, 32, 431-453.
- Lotfi, M., Bach, B., Amini, M., & Simonsen, E. (2018). Structure of DSM-5 and ICD-11 personality domains in Iranian community sample. *Personality and Mental Health*, 12(2), 155-169. doi:10.1002/pmh.1409
- Maples, J. L., Carter, N. T., Few, L. R., Crego, C., Gore, W. L., Samuel, D. B., Williamson, R. L., Lynam, D. R., Widiger, T. A., Markon, K. E., Krueger, R. F., & Miller, J. D. (2015). Testing whether the DSM-5 personality disorder trait model can be measured with a reduced set of items: An item response theory investigation of the Personality Inventory for DSM-5. *Psychological Assessment*, 27(4), 1195-1210. doi:10.1037/pas0000120
- McCrae, R. R., & Costa Jr, P. T. (1997). Personality trait structure as a human universal. *American Psychologist*, 52, 509-516.

- McCrae, R. R., & John, O. P. (1992). An introduction to the five-factor model and its applications. *Journal of Personality*, 60(2), 175-215.
- Morey, L. C. (1991). Personality assessment inventory. Odessa, FL: Psychological Assessment Resources.
- Mullins-Sweatt, S. N., Jamerson, J. E., Samuel, D. B., Olson, D. R., & Widiger, T. A. (2006). Psychometric properties of an abbreviated instrument of the five-factor model. *Assessment*, 13(2), 119-137. doi:10.1177/1073191106286748
- Pires, R., Sousa Ferreira, A., & Guedes, D. (2017). The psychometric properties of the Portuguese version of the Personality Inventory for DSM-5. *Scandinavian Journal of Psychology*, 58(5), 468-475. doi:10.1111/sjop.12383
- Quilty, L. C., Ayearst, L., Chmielewski, M., Pollock, B. G., & Bagby, R. M. (2013). The psychometric properties of the personality inventory for DSM-5 in an APA DSM-5 field trial sample. *Assessment*, 20(3), 362-369. doi:10.1177/1073191113486183
- Roskam, I., Galdiolo, S., Hansenne, M., Massoudi, K., Rossier, J., Gicquel, L., & Rolland, J. P. (2015). The Psychometric Properties of the French Version of the Personality Inventory for DSM-5. *PLoS One*, 10(7), e0133413. doi:10.1371/journal.pone.0133413
- Russell, D. W. (2016). In Search of Underlying Dimensions: The Use (and Abuse) of Factor Analysis in Personality and Social Psychology Bulletin. *Personality and Social Psychology Bulletin*, 28(12), 1629-1646. doi:10.1177/014616702237645
- Samuel, D. B., Hopwood, C. J., Krueger, R. F., Thomas, K. M., & Ruggero, C. J. (2013). Comparing methods for scoring personality disorder types using maladaptive traits in DSM-5. *Assessment*, 20(3), 353-361. doi:10.1177/1073191113486182

- Shedler, J., Beck, A., Fonagy, P., Gabbard, G. O., Gunderson, J. G., Kernberg, O., Michels, R., & Westen, D. (2010). Personality Disorders in DSM-5. *American Journal of Psychiatry*, 167(9).
- Soldz, S., & Vaillant, C. O. (1999). The Big Five personality traits and the life course: A 45-year longitudinal study. *Journal of Research in Personality*, 33, 208-232.
- Somma, A., Borroni, S., Maffei, C., Giarolli, L. E., Markon, K. E., Krueger, R. F., & Fossati, A. (2017). Reliability, factor structure, and associations with measures of problem relationship and behavior of the personality inventory DSM-5 in a sample of Italian community-dwelling adolescents. *Journal of Personality Disorders*, 31(5), 624-646.
- South, S. C., & Jarnecke, A. M. (2017). Structural equation modeling of personality disorders and pathological personality traits. *Personality Disorders: Theory, Research, and Treatment*, 8(2), 113-129. doi:10.1037/per0000215
- Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics.*: Allyn & Bacon/Pearson Education.
- Thimm, J. C., Jordan, S., & Bach, B. (2017). Hierarchical Structure and Cross-Cultural Measurement Invariance of the Norwegian Version of the Personality Inventory for DSM-5. *Journal of Personality Assessment*, 99(2), 204-210. doi:10.1080/00223891.2016.1223682
- Thomas, K. M., Yalch, M. M., Krueger, R. F., Wright, A. G., Markon, K. E., & Hopwood, C. J. (2013). The convergent structure of DSM-5 personality trait facets and five-factor model trait domains. *Assessment*, 20(3), 308-311. doi:10.1177/1073191112457589
- Van den Broeck, J., Bastiaansen, L., Rossi, G., Dierckx, E., De Clercq, B., & Hofmans, J. (2014). Hierarchical structure of maladaptive personality traits in older adults: joint

- factor analysis of the PID-5 and the DAPP-BQ. *Journal of Personality Disorders*, 28(2), 198–211.
- Velicer, W. F. (1976). Determining the number of components from the matrix of partial correlations. *Psychometrika*, 41(3), 321-327.
- Wright, A. G., & Simms, L. J. (2014). On the structure of personality disorder traits: conjoint analyses of the CAT-PD, PID-5, and NEO-PI-3 trait models. *Personality Disorders: Theory, Research, and Treatment*, 5(1), 43-54. doi:10.1037/per0000037
- Wright, A. G., Thomas, K. M., Hopwood, C. J., Markon, K. E., Pincus, A. L., & Krueger, R. F. (2012). The hierarchical structure of DSM-5 pathological personality traits. *Journal of Abnormal Psychology*, 121(4), 951-957. doi:10.1037/a0027669
- Zanarini, M. C., Vujanovic, A. A., Parachini, E. A., Boulanger, J. L., Frankenburg, F. R., & Hennen, J. (2003). A screening measure for BPD: the McLean Screening Instrument for Borderline Personality Disorder. *Journal of Personality Disorders*, 17(6), 568-573.
- Zimmermann, J., Altenstein, D., Krieger, T., Holtforth, M. G., Pretsch, J., Alexopoulos, J., . . . Leising, D. (2014). The structure and correlates of self-reported DSM-5 maladaptive personality traits: findings from two German-speaking samples. *Journal of Personality Disorders*, 28(4), 518–540.

Table 1.

Proposed correspondence between domains of the FFM and the AMPD

FFM Domains	Corresponding maladaptive variant trait domain in the AMPD
Agreeableness	Antagonism
Conscientiousness	Disinhibition
Extraversion	Detachment
Neuroticism	Negative Affectivity
Openness	Psychoticism

Table 2.

Factor analytic studies of the 220-item PID-5

Study	Sample	Model	Software	Estimation	Factor Extraction	Rotation	Solution	Congruency coefficients	Cross loadings	Notes
<i>Independent Analyses</i>										
<i>English</i>										
Krueger et al. (2012)	264 adults representative of the US population	EFA	MPlus	ML	Interpretability MAP PA BE	CF-Equamax (oblique) and target	MAP: 3-factor PA: 6-factor BE: 5-factor 6-factor under-identified 5-factor retained	Target: .89-.97	X: anhedonia, anxiousness, callousness, deceitfulness, depressivity, hostility, perseveration, restricted affectivity, rigid perfectionism, risk taking & suspiciousness F: submissiveness	
Wright et al. (2012)	2,461 undergraduates	EFA	MPlus 6.11	ML	Theory – FFM Interpretability BE PA Model fit statistics	Varimax and target	PA: 4-factor BE: 5-factor Model fit statistics: 6-factor 5-factor retained	Target: .96-.99 Exploratory: .76-.91	X: depressivity, perseveration, restricted affectivity & risk taking F: submissiveness & suspiciousness D: perseveration	
Quilty et al. (2013)	201 Canadian outpatients	EFA	MPlus 4.2	ML	PA MAP		PA: 1-factor structure for all domains and all facet scales (except risk taking) MAP: 1-factor for all domains and all facet scales (except depressivity, hostility and risk taking)			Item-level analyses
Maples et al. (2015)	1,417 adults – Mturk and undergraduates 109 adults receiving psychological or psychiatric treatment	EFA		PAF	Theory – FFM	Equamax	2-5 factors extracted 5-factor retained		X: anhedonia, anxiousness, attention seeking, callousness, cognitive and perceptual dysregulation, deceitfulness, depressivity, distractibility, eccentricity, hostility, irresponsibility, manipulateness, perseveration, restricted affectivity, rigid perfectionism, suspiciousness & withdrawal D: hostility, rigid perfectionism	

Creswell et al. (2016)	877 adults – data collected online – 39% reported they were receiving mental health tx	EFA	MPlus 7	ML	Theory – FFM	Equamax (oblique)	5-factor retained	W/ Krueger et al.: .89-.96 W/ Wright et al.: .92-.97	X: anhedonia & hostility F: suspiciousness & submissiveness D: hostility, depressivity, rigid perfectionism	
<i>Translations</i>										
De Fruyt et al. (2013)	240 undergraduate students	EFA	MPlus	ML	Model fit statistics	CF-Equamax (oblique)	Model fit statistics: 5-factor	W/ Wright et al.: .93-.97 W/ Krueger et al.: .82-.97	X: restricted affectivity, hostility, perseveration, anhedonia, depressivity, callousness, rigid perfectionism F: submissiveness D: restricted affectivity, perseveration	Dutch translation
Fossati et al. (2013)	710 community adults	CFA	R	WLS	PA		PA, Hull and fit statistics: 1-factor structure for all facet scales (except risk taking) 3 models evaluated: CFA fit indices support 5-factor structure			Italian translation Item-level analyses
De Clercq et al. (2014)	434 adolescents	EFA	MPlus 6.12		PA MAP Theory – FFM	CF-Equamax (oblique)	MAP: 4-factor PA: 3-factor Model fit statistics and theory: 5-factor	W/ Krueger et al.: .86-.97 W/ Wright et al.: .89-.95 W/ De Fruyt et al.: .89-.96	X: callousness, depressivity, rigid perfectionism D: depressivity, rigid perfectionism	Dutch translation Age range 11-17
Van den Broeck et al. (2014)	173 elderly adults	EFA	MPlus 7		Model fit statistics	Target (oblique)	Model fit statistics: 5-factor	W/ Krueger et al.: .84-.96	X: anhedonia, callousness, deceitfulness, depressivity, distractibility, eccentricity, hostility, impulsivity, perceptual dysregulation, perseveration, rigid perfectionism, risk taking, suspiciousness F: submissiveness D: perseveration, callousness, hostility, impulsivity, risk taking, perceptual dysregulation	Dutch translation

Zimmermann et al. (2014)	Sample 1: 577 community adults and students Sample 2: 212 adult inpatients	CFA EFA	R 2.15.2	CFA – robust WLS EFA – ML	CFA – Model fit statistics MAP PA Model fit statistics	EFA – target and Promax	CFA fit statistics: 1-factor structure for all facet scales (except emotional lability, hostility, perseveration, manipulateness which demonstrated 2-factor structure) Sample 1 PA, MAP and EFA fit statistics: 5-factor Sample 2 PA: 4-factor	W/ Krueger et al. empirical: .92-.98 W/ Krueger et al. ideal: .77-.97 Sample 2 W/ sample 1 empirical: .79-.95 Sample 2 W/ sample 1 ideal: .55-.94	X: anxiousness, attention seeking, callousness, depressivity, hostility, intimacy avoidance, restricted affectivity, rigid perfectionism, risk taking D: hostility	German translation CFA Item-level analyses
Gutierrez et al. (2015)	446 outpatients 1,036 community participants	EFA	SPSS 17, AMOS 16, R 3.2.1	ULS Confirmed results with ML	PA MAP Hull test Model fit statistics	Procrustes target	MAP, PA and hull test: 1-factor structure for all facet scales (except emotional lability: 2-factor) EFA MAP, PA and hull test: 2- or 3- factors Eigenvalues: up to 5-factors	W/ Krueger et al.: .96-.99	X: anhedonia, callousness, depressivity, perseveration, restricted affectivity, rigid perfectionism, risk taking	Spanish translation Age range 15-89
Roksam et al. (2015)	2,532 undergraduate students	EFA	SPSS 22	ULS	PA Model fit statistics	Equamax (oblique)	PA: 1-factor structure for all facet scales (except depressivity, callousness, perceptual dysregulation) and domain scales (except negative affectivity) which demonstrated 2-factor structure EFA PA and fit statistics: 5-factor	W/ Krueger et al.: .86-.97	X: anhedonia, callousness, depressivity, distractibility, eccentricity, hostility, irresponsibility, perceptual dysregulation, perseveration, suspiciousness, rigid perfectionism, risk taking D: hostility, depressivity, suspiciousness, rigid perfectionism	French translation
Bastiaens, Claes et al. (2016)	240 inpatients	CFA ESEM	MPlus 7.2	CFA – WLSMV EFA – ML	Theory – FFM Model fit statistics	Target	CFA: 1-factor structure satisfactory for all facets (except for hostility and emotional lability) ESEM: 5-factor model nearly acceptable. Modified to allow error covariance for impulsivity and grandiosity and 5-factor model fit was acceptable	W/ Krueger et al.: .89-.97	X: anhedonia, callousness, deceitfulness, depressivity, distractibility, eccentricity, emotional lability, hostility, irresponsibility, perseveration, suspiciousness D: depressivity, hostility, suspiciousness	Dutch translation CFA Item-level analyses
Bastiaens, Smits et al. (2016)	509 community adults	CFA ESEM	MPlus 7.3	CFA – WLSMV ESEM – ML	Theory – FFM Model fit statistics	Target	CFA: 1-factor structure for all facets (except risk taking) ESEM: 5-factor solution adequate	W/ Krueger et al.: .86-.97	X: anhedonia, callousness, deceitfulness, depressivity, eccentricity, hostility, restricted affectivity, rigid perfectionism, risk taking D: depressivity, hostility, rigid perfectionism, risk taking	Dutch translation CFA Item-level analyses

Bo et al. (2016)	195 adult outpatients 924 community participants	EFA	MPlus 7	ML	Theory – FFM Interpretability PA MAP Hull test	CF-Equamax	PA: 3-factor MAP and hull test: 2-factor 5-factor model retained	W/ Krueger et al.: .90-.98 W/ Wright et al.: .92-.98 W/ De Fruyt et al.: .92-.97 W/ Zimmermann et al.: .77-.98	X: risk taking F: perseverance, suspiciousness, hostility D: risk taking, rigid perfectionism	Danish translation
Al-Attayah et al (2017)	710 undergraduate students	CFA	EQS 6.2		Model fit statistics		CFI: 1-factor structure for all facets SB- χ^2 : unidimensional fit for all except impulsivity, intimacy avoidance, irresponsibility, submissiveness SRMR & RMSEA: unidimensional fit for all facets except manipulateness 5-factor domain model fit			Arabic translation
Bach, Sellbom and Simonsen (2017)	598 outpatients 598 matched community adults	ESEM	MPlus 7.3	ML	Model fit statistics	Geomin (oblique)	5-factor solution retained		X – clinical: anxiousness, depressivity, restricted affectivity, rigid perfectionism, risk taking X – non-clinical: anhedonia, callousness, depressivity, attention seeking, emotional lability, perseverance, risk taking, submissiveness, suspiciousness D – clinical: perseverance D – non-clinical: perseverance, suspiciousness, risk taking, rigid perfectionism	Danish translation
Somma et al (2017)	1,264 adolescent high school students	CFA ESEM	MPlus 7.3	CFA – WLSMV ESEM – WLSMV and ML	Model fit statistics	Target	1-factor structure for all facets except eccentricity, emotional lability, hostility, intimacy avoidance, manipulateness, risk taking All fit statistics suggested acceptable fit for 5-factor domain model	W/ Krueger et al.: .86-.98	X: hostility, perseverance, anhedonia, depressivity, attention seeking, distractibility, impulsivity, rigid perfectionism, risk taking, irresponsibility, eccentricity, unusual beliefs D: hostility, perseverance, distractibility, eccentricity, unusual beliefs and experiences	Italian translation Age range 13-19 CFA Item-level analyses

Thimm et al. (2017)	503 students	EFA	MPlus 7.3	ML	Model fit statistics	CF-Equamax (oblique)	Model fit statistics: 5-factor solution acceptable or close to acceptable	W/ Krueger et al.: .88-.96 W/ Wright et al.: .88-.96 W/ de Fruyt et al.: .87-.97 W/ Zimmermann et al.: .74-.95 W/ Bastiaens et al.: .92-.96 W/ Bo et al.: .93-.98 W/ Roksam et al.: .89-.94 W/ Gutierrez et al.: .92-.96	X: depressivity, risk taking, F: submissiveness, suspiciousness D: depressivity	Norwegian translation
Lotfi et al (2018)	285 community adults	ESEM	MPlus 7.3	ML	Theory – FFM Interpretability Model fit statistics	Geomin	Model fit statistics: 5-factor PA: 4-factor	W/ Krueger et al.: .88-.95 W/ Bach et al.: .80-.96 W/ Gutiérrez et al.: .87-.96 W/ Bastiaens and Claes et al.: .82-.94	X: impulsivity F: depressivity, suspiciousness D: suspiciousness, deceitfulness, callousness, distractibility	Persian translation
<i>Joint Analyses</i>										
<i>English</i>										
Anderson et al. (2012)	397 US undergraduate students	Joint-EFA with the MMPI-2-RF		ML	PA	Promax (oblique)	PA: 5-factor 1) Negative Affectivity 2) Disinhibition 3) Detachment 4) Antagonism 5) Psychoticism		F: suspiciousness D: distractibility	
Ashton et al. (2012)	378 Canadian undergraduate students	Joint-EFA with the NEO-PI-3FH			Scree plot Theory – HEXACO		Scree Plot: up to 8-factors 7-factor model retained for HEXACO interpretation 1) Emotionality 2) Extraversion 3) Honesty-Humility 4) Conscientiousness 5) Agreeableness 6) Schizotypy/Dissociation 7) Openness to Experience		X: anhedonia, attention seeking, callousness, depressivity, distractibility, eccentricity, emotional lability, grandiosity, hostility, impulsivity, restricted affectivity, rigid perfectionism, risk taking, submissiveness, perceptual dysregulation, perseveration, unusual beliefs and experiences	
Thomas et al. (2013)	808 US undergraduate students	Joint-EFA with the FFMRF	MPlus 6	ML	PA Interpretability	Geomin (oblique)	PA: 5-factor 1) Neuroticism – Negative Affectivity 2) Low Agreeableness – Antagonism 3) Low Extraversion – Detachment 4) Openness to Experience – Psychoticism 5) Conscientiousness – Low Disinhibition		X: anhedonia, callousness, depressivity, hostility, impulsivity, perceptual dysregulation, rigid perfectionism, unusual beliefs and experiences F: irresponsibility, risk taking, suspiciousness D: distractibility, hostility	

Hopwood et al. (2013)	1,001 undergraduate students	Joint-EFA with PAI Joint-ESEM with PAI		EFA – PAF ESEM – ML	EFA – PA ESEM – Model fit statistics	EFA – Promax (oblique) ESEM – target	EFA PA: 7-factor 1) Negative Affectivity 2) Cognitive/Health Problems 3) Detachment 4) Antagonism 5) Impulsivity 6) Aggression 7) Assertiveness ESEM Model fit statistics: acceptable fit for 5-factor model		ESEM X: depressivity ESEM F: attention seeking, intimacy avoidance, eccentricity, perseveration, restricted affectivity, submissiveness, suspiciousness ESEM D: irresponsibility, rigid perfectionism	
Gore & Widiger (2013)	445 undergraduate students	Joint-CFA with NEO-PI-R, 5DPT and IPC-5 Joint-ESEM with NEO-PI-R, 5DPT and IPC-5	MPlus 6.12	ESEM – ML	Model fit statistics	ESEM – Geomin (oblique)	CFA: 5-factor solution did not result in adequate fit ESEM – closer but still not adequate fit for 5-factor solution – to control for measure variance, specified high inter-correlations across domains – fit was then adequate to excellent depending on index 1) Antagonism 2) Neuroticism 3) Extraversion 4) Conscientiousness 5) Openness		X: PID-5 detachment domain primarily loaded onto Detachment factor, but also substantially onto Neuroticism factor	Domain level analyses
Griffin & Samuel (2014)	336 undergraduate students	Joint-EFA with NEO-PI-R		PAF	PA MAP	Oblimin (oblique)	PA: 6-factor MAP: 10-factor – not pursued 6-factor model considered but not consistent with any prior models 5-factor model retained - identifiable as the FFM		X: callousness, depressivity, distractibility, hostility, impulsivity, irresponsibility, perceptual dysregulation, rigid perfectionism, suspiciousness D: hostility, impulsivity, irresponsibility, risk taking, suspiciousness	
Wright & Simms (2014)	628 US adults reporting receiving mental health tx within past 2 years	Joint-EFA with CAT-PD-SF and NEO-PI-3FH ESEM	MPlus 7		PA Theory – FFM Interpretability	Geomin (oblique)	PA: suggested up to 6-factors Considered 4-, 5- and 6-factor solutions 5-factor solution retained as most theoretically coherent ESEM also suggested 5-factor solution	EFA and ESEM: .91-1.00	EFA X: anhedonia, attention seeking, callousness, eccentricity, hostility, impulsivity, irresponsibility, perceptual dysregulation, suspiciousness EFA D: depressivity, distractibility, eccentricity, hostility, impulsivity, irresponsibility, perceptual dysregulation, risk taking, suspiciousness	
Translations										

De Fruyt et al. (2013)	240 undergraduate students	Joint-EFA with the NEO-PI-3	MPlus		MAP PA	CF-Equamax (oblique)	MAP: 6-factor PA: 5-factor		X: anhedonia, attention seeking, depressivity, hostility, impulsivity, intimacy avoidance, irresponsibility, manipulateness, perseveration, restricted affectivity, rigid perfectionism, risk taking, suspiciousness	Dutch translation FFM domains and PID-5 facets used in EFA
Van den Broeck et al. (2014)	173 community adults	Joint-EFA with the DAPP-BQ	MPlus 7	PCA	MAP PA Theory – FFM Interpretability	Varimax	MAP: 5-factor PA: 4-factor 5-factor model retained		X: depressivity, perseveration, callousness, impulsivity, distractibility, eccentricity, perceptual dysregulation, suspiciousness	Dutch translation

Note: X: facets which cross-loaded; F: facets which failed to load; D: facets with primary loading contradicting DSM listing

Acronyms: BE: bootstrapped eigenvalues; CAT-PD-SF: Computerized Adaptive Assessment of Personality Disorder-Short Form; CFA: confirmatory factor analysis; DAPP-BQ: Dimensional Assessment of Personality Pathology-Basic Questionnaire; EFA: exploratory factor analysis; ESEM: exploratory structural equation modeling; FFM: Five Factor Model; FFMRF: Five Factor Model Rating Form; HEXACO - Honesty-Humility, Emotionality, Extraversion, Agreeableness, Conscientiousness, Openness to Experience Model of Personality; IPC-5: Inventory of Personal Characteristics-5; MAP: Velicer's (1976) Minimum Average Partial Test; ML: maximum likelihood; MMPI-2-RF: Minnesota Multiphasic Personality Inventory-2-Restructured Form; NEO-PI-R: NEO Personality Inventory-Revised; NEO-PI-3FH: NEO Personality Inventory-3-First Half; PA: parallel analysis (Horn, 1965); PAF: principal axis factoring; PAI: Personality Assessment Inventory; PCA: principal component analysis; ULS: unweighted least squares; W/: with; WLS: weighted least squares; 5DPT: the 5-Dimensional Personality Test

Table 3.

Descriptive statistics, internal consistency and CFA standardized loading summary statistics of the PID-5 facet and domain scales

Scale (number of items or scales)	<i>n</i>	Mean	Std. Deviation	Skewness	Kurtosis	α	Median standardized factor loading of items/scales in unmodified models [#]
Facets							
Anhedonia (8)	967	.94	.63	.67	-.19	.86	.76
Anxiousness (9)	960	1.55	.73	.00	-.88	.89	.71 ^A
Attention Seeking (8)	951	.91	.67	.46	-.45	.88	.71
Callousness (14)	947	.46	.49	1.49	2.04	.90	.70 ^A
Deceitfulness (10)	957	.75	.56	.75	.05	.86	.67 ^A
Depressivity (14)	936	.69	.68	.95	.20	.95	.79
Distractibility (9)	947	1.07	.69	.22	-.73	.90	.74
Eccentricity (13)	947	.90	.72	.55	-.48	.94	.75
Emotional Lability (7)	962	1.11	.75	.38	-.63	.88	.71
Grandiosity (6)	967	.68	.57	.97	.74	.80	.63
Hostility (10)	957	.91	.59	.48	-.28	.86	.57
Impulsivity (6)	955	.84	.65	.62	-.31	.84	.77
Intimacy Avoidance (6)	969	.67	.62	.89	.15	.83	.65
Irresponsibility (7)	971	.61	.52	.93	.46	.77	.61
Manipulativeness (5)	974	.84	.67	.61	-.19	.82	.67
Perceptual Dysregulation (12)	960	.73	.58	.79	.20	.88	.62
Perseveration (9)	954	.98	.62	.27	-.52	.86	.62
Restricted Affectivity (7)	958	.87	.65	.66	-.03	.84	.67
Rigid Perfectionism (10)	956	1.12	.62	.32	-.32	.87	.63
Risk Taking (14)	949	1.31	.48	.01	.03	.82	.54 ^C
Separation Insecurity (7)	966	.94	.68	.48	-.42	.85	.69
Submissiveness (4)	965	1.18	.71	.02	-.82	.81	.73
Suspiciousness (7)	963	1.06	.49	.35	-.15	.63	.55 ^B
Unusual Beliefs and Experiences (8)	961	.74	.60	.83	.18	.82	.58
Withdrawal (10)	956	1.04	.65	.32	-.45	.90	.69
Domains							

Negative Affectivity (6)	929	1.21	.61	.21	-.53	.86	.78
Detachment (6)	931	.88	.52	.52	-.21	.86	.77
Antagonism (5)	936	.76	.52	.76	.24	.88	.80
Disinhibition (5)	918	.83	.53	.50	-.27	.72	.85
Psychoticism (3)	914	.79	.58	.66	-.08	.89	.95

Note: Means are of average scores;# = median item loadings for facets scales is from individual facet CFA models. Standardized loadings for items and facets in each domain model are presented in

tables 6-10; A = one item had a standardized factor loading of <.32; B = two items had a standardized factor loading of <.32; C = six items had a standardized factor loading of <.32

Table 4.

CFA model fit statistics of the PID-5 facet scales

Scale	Initial fit statistics					Post-modification fit statistics						
	χ^2	RMSEA	CFI	TLI	SRMR	χ^2	RMSEA	CFI	TLI	SRMR	$\Delta \chi^2$	w
Anhedonia	130.86****	.08	.95	.94	.05	35.72*	.03	.99	.99	.02	95.17	.31
Anxiousness	158.15****	.07	.96	.94	.03	114.59****	.06	.97	.96	.03	43.57	.21
Attention Seeking	91.53****	.06	.97	.96	.03	-	-	-	-	-	-	-
Callousness	164.24****	.03	.98	.97	.03	-	-	-	-	-	-	-
Deceitfulness	273.41****	.08	.91	.89	.04	135.06****	.06	.96	.95	.03	138.35	.22
Depressivity	529.16****	.08	.92	.91	.05	313.92****	.06	.96	.95	.03	215.24	.21
Distractibility	129.92****	.06	.97	.96	.03	-	-	-	-	-	-	-
Eccentricity	293.05****	.06	.96	.95	.03	-	-	-	-	-	-	-
Emotional Lability	302.60****	.15	.88	.82	.06	33.43****	.05	.99	.98	.02	269.17	.30
Grandiosity	58.09****	.07	.96	.93	.04	18.25*	.04	.99	.98	.02	39.84	.20
Hostility	244.41****	.08	.92	.90	.05	118.45****	.05	.97	.96	.03	125.96	.21
Impulsivity	10.75	.01	1.00	1.00	.01	-	-	-	-	-	-	-
Intimacy Avoidance	23.88**	.04	.99	.98	.02	-	-	-	-	-	-	-
Irresponsibility	22.06	.02	.99	.99	.02	-	-	-	-	-	-	-

Manipulativeness	58.49****	.10	.95	.90	.03	22.34****	.07	.98	.96	.02	36.15	.19
Perceptual Dysregulation	273.38****	.06	.92	.91	.04	200.66****	.05	.95	.94	.04	72.72	.19
Perseveration	106.80****	.06	.97	.95	.03	-	-	-	-	-	-	-
Restricted Affectivity	84.12****	.07	.96	.94	.03	61.36****	.06	.97	.95	.03	22.76	.15
Rigid Perfectionism	149.31****	.06	.96	.94	.03	104.69****	.05	.97	.96	.03	44.63	.21
Risk Taking	1667.08****	.15	.58	.51	.15	420.16****	.07	.91	.89	.06	1246.92	1.13
Separation Insecurity	145.60****	.10	.93	.90	.05	65.76****	.07	.97	.95	.03	79.84	.20
Submissiveness	1.22	.00	1.00	1.00	.01	-	-	-	-	-	-	-
Suspiciousness	88.90****	.07	.92	.88	.04	30.77****	.04	.98	.96	.02	58.13	.17
Unusual Beliefs and Experiences	91.95****	.06	.95	.93	.04	69.60****	.05	.97	.95	.03	22.35	.15
Withdrawal	398.63****	.10	.89	.86	.05	163.49****	.06	.96	.95	.03	235.14	.35

Note. **** $p < .001$; *** $p < .005$; * $p < .05$; RMSEA = Root Mean Square Error of Approximation; CFI = Comparative Fit Index; TLI = Tucker Lewis Index; SRMR = Standardized Root Mean Residual

Table 5.

CFA model fit statistics of the PID-5 domain scales and hierarchical structure

Scale	Initial fit statistics					Post-aim 1 modification fit statistics					Post-aim 2 modification fit statistics								
	χ^2	RMSEA	CFI	TLI	SRMR	χ^2	RMSEA	CFI	TLI	SRMR	$\Delta \chi^2$	w	χ^2	RMSEA	CFI	TLI	SRMR	$\Delta \chi^2$	w
AN	2620.81*	.05	.89	.89	.06	2430.71*	.04	.90	.90	.06	190.10	.20	-	-	-	-	-	-	-
DE	4355.03*	.05	.87	.86	.07	3623.06*	.04	.90	.89	.07	731.97	.26	-	-	-	-	-	-	-
DIS	4484.07*	.06	.79	.78	.10	3183.40*	.05	.87	.86	.08	1248.15	1.13	2705.80*	.04	.90	.89	.06	477.60	.35
NA	3135.99*	.05	.88	.88	.06	2648.87*	.04	.91	.90	.07	487.12	.24	-	-	-	-	-	-	-
PSY	1518.34*	.05	.92	.91	.05	1420.51*	.04	.93	.92	.05	97.83	.18	-	-	-	-	-	-	-
PID-5	49867.96*	.03	.77	.77	.09	46898.27*	.03	.80	.79	.08	2969.69	.32	46519.14*	.03	.80	.80	.08	379.13	.31

Note. * $p < .001$; AN = antagonism; DE = detachment; DIS = disinhibition; NA = negative affectivity; PSY = psychoticism; PID-5 = Personality Inventory for DSM-5 hierarchical structure; RMSEA = Root Mean Square Error of Approximation; CFI = Comparative Fit Index; TLI = Tucker Lewis Index; SRMR = Standardized Root Mean Residual

Table 6.

CFA standardized factor loadings of the unmodified antagonism domain model

Antagonism items and facet scales	Attention seeking	Callousness	Deceitfulness	Grandiosity	Manipulativeness	Antagonism
14	.76					
43	.67					
74	.75					
111	.64					
113	.56					
173	.71					
191	.69					
211	.80					
11		.60				
13		.72				
19		.81				
54		.75				
72		.77				
73		.54				
90		.20				
153		.81				
166		.82				
183		.70				
198		.65				
200		.65				
207		.71				
208		.61				
41			.59			
53			.72			
56			.71			
76			.70			

126	.66			
134	.63			
142	.15			
206	.74			
214	.63			
218	.67			
40		.79		
65		.46		
114		.79		
179		.48		
187		.61		
197		.69		
107			.70	
125			.71	
162			.68	
180			.61	
219			.73	
Attention Seeking				.73
Callousness				.80
Deceitfulness				.95
Grandiosity				.80
Manipulativeness				.91

Note. Standardized factor loadings > .32 in bold

Table 7.

CFA standardized factor loadings of the unmodified detachment domain model

Detachment items and facet scales	Anhedonia	Depressivity	Intimacy Avoidance	Restricted Affectivity	Suspiciousness	Withdrawal	Detachment
1	.71						
23	.78						
26	.80						
30	.31						
124	.80						
155	.32						
157	.82						
189	.73						
27		.82					
61		.79					
66		.82					
81		.77					
86		.60					
104		.79					
119		.62					
148		.93					
151		.80					
163		.82					
168		.80					
169		.91					
178		.61					
212		.64					
89			.86				
97			.52				
108			.54				
120			.60				

145	.80			
203	.70			
8		.68		
45		.61		
84		.60		
91		.70		
101		.62		
167		.72		
184		.67		
2			.63	
103			.52	
117			.52	
131			.13	
133			.66	
177			.01	
190			.69	
10				.73
20				.49
75				.71
82				.74
136				.69
146				.62
147				.64
161				.73
182				.68
186				.69
Anhedonia				.97
Depressivity				.90
Intimacy Avoidance				.51
Restricted Affectivity				.64
Suspiciousness				.80

Withdrawal

.75

Note. Standardized factor loadings >.32 in bold

Table 8.

CFA standardized factor loadings of the unmodified disinhibition domain model

Disinhibition items and facet scales	Distractibility	Impulsivity	Irresponsibility	Rigid Perfectionism	Risk-taking	Disinhibition
6	.64					
29	.74					
47	.56					
68	.69					
88	.70					
118	.78					
132	.72					
144	.79					
199	.74					
4		.79				
16		.79				
17		.77				
22		.68				
58		.33				
204		.77				
31			.72			
129			.65			
156			.64			
160			.58			
171			.58			
201			.54			
210			.29			
34				.72		
49				.58		
105				.70		
115				.66		

123	.76	
135	.53	
140	.50	
176	.62	
196	.64	
220	.57	
3		.75
7		.16
35		.03
39		.71
48		.76
67		.60
69		.57
87		.05
98		.12
112		.43
159		.75
164		.07
195		.69
215		.01
Distractibility		.69
Impulsivity		.95
Irresponsibility		.85
Rigid		.39
Perfectionism		
Risk-taking		.85

Note. Standardized factor loadings >.32 in bold

Table 9.

CFA standardized factor loadings of the unmodified negative affectivity domain model

Negative Affectivity items and facet scales	Anxiousness	Emotional Lability	Hostility	Perseveration	Separation Insecurity	Submissiveness	Negative Affectivity
79	.82						
93	.65						
95	.66						
96	.24						
109	.80						
110	.78						
130	.71						
141	.69						
174	.76						
18		.69					
62		.71					
102		.67					
122		.79					
138		.67					
165		.76					
181		.71					
28			.71				
32			.45				
38			.79				
85			.50				
92			.76				
116			.55				
158			.75				
170			.56				
188			.59				

216	.57			
46		.55		
51		.51		
60		.71		
78		.61		
80		.73		
100		.64		
121		.65		
128		.71		
137		.64		
12			.68	
50			.77	
57			.52	
64			.61	
127			.76	
149			.71	
175			.64	
9				.67
15				.76
63				.67
202				.76
Anxiousness				.80
Emotional Lability				.86
Hostility				.72
Perseveration				.86
Separation				.76
Insecurity				
Submissiveness				.65

Note. Standardized factor loadings >.32 in bold

Table 10.

CFA standardized factor loadings of the unmodified psychoticism domain model

Psychoticism items and facet scales	Eccentricity	Perceptual Dysregulation	Unusual Beliefs and Experiences	Psychoticism
94	.53			
99	.67			
106	.71			
139	.72			
143	.54			
150	.41			
194	.54			
209	.67			
36		.61		
37		.67		
42		.60		
44		.69		
59		.55		
77		.64		
83		.58		
154		.65		
192		.63		
193		.58		
213		.58		
217		.73		
94			.53	
99			.67	
106			.71	
139			.72	
143			.54	
150			.41	

194		.54	
209		.67	
Eccentricity			.84
Perceptual Dysregulation			.95
Unusual Beliefs and Experiences			.95

Note. Standardized factor loadings >.32 in bold

Table 11.

CFA standardized facet factor loadings and domain covariance of the unmodified hierarchical PID-5 model

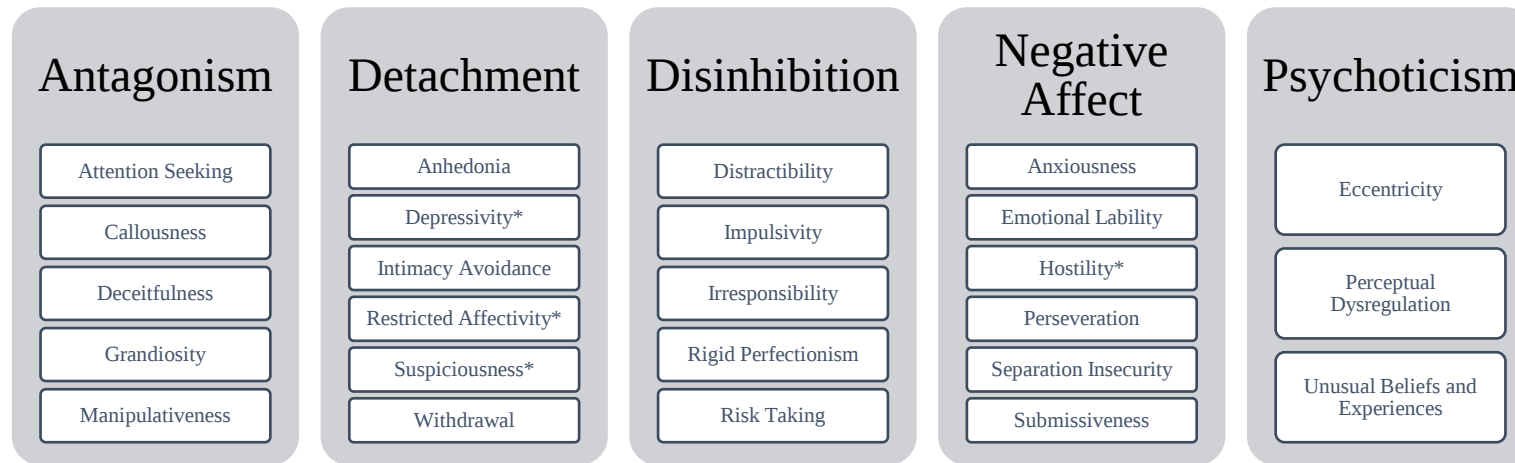
	Antagonism	Detachment	Disinhibition	Negative Affectivity	Psychoticism
Attention Seeking	.73				
Callousness	.83				
Deceitfulness	.96				
Grandiosity	.78				
Manipulativeness	.88				
Anhedonia		.92			
Depressivity		.90			
Intimacy Avoidance		.53			
Restricted Affectivity		.65			
Suspiciousness		.88			
Withdrawal		.76			
Distractibility			.74		
Impulsivity			.86		
Irresponsibility			.90		
Rigid Perfectionism			.52		
Risk-taking			.81		
Anxiousness				.74	
Emotional Lability				.81	
Hostility				.76	
Perseveration				.92	
Separation Insecurity				.73	
Submissiveness				.64	
Eccentricity					.84
Perceptual Dysregulation					.99
Unusual Beliefs and Experiences					.90
Antagonism		.62	.83	.62	.70
Detachment			.75	.82	.82

Disinhibition	.84	.88
Negative Affectivity		.84

Note. Standardized factor loadings > .32 in bold

Figure 1.

Hierarchical organization of the DSM-5 AMPD trait domains and facets



Note. * - facets which are cross-listed on more than one domain in the DSM-5 AMPD text

Figure 2.

Proposed hierarchical latent factor structure of the PID-5

