

DSM-5 Alternative Personality Disorder Model Traits as Maladaptive Extreme Variants of the Five-Factor Model: An Item-Response Theory Analysis

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Over the past two decades, evidence has suggested that personality disorders (PDs) can be conceptualized as extreme, maladaptive variants of general personality dimensions, rather than discrete categorical entities. Recognizing this literature, the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5)* alternative PD model in Section III defines PDs partially through 25 maladaptive traits that fall within 5 domains. Empirical evidence based on the self-report measure of these traits, the Personality Inventory for *DSM-5* (PID-5), suggests that these five higher-order domains share a structure and correlate in meaningful ways with the five-factor model (FFM) of general personality. In the current study, item response theory was used to compare the *DSM-5* alternative PD model traits to those from a normative FFM inventory (the International Personality Item Pool–NEO [IPIP–NEO]) in terms of their measurement precision along the latent dimensions. Within a combined sample of 3,517 participants, results strongly supported the conclusion that the *DSM-5* alternative PD model traits and IPIP–NEO traits are complimentary measures of 4 of the 5 FFM domains (with perhaps the exception of openness to experience vs. psychoticism). Importantly, the two measures yield largely overlapping information curves on these four domains. Differences that did emerge suggested that the PID-5 scales generally have higher thresholds and provide more information at the upper levels, whereas the IPIP–NEO generally had an advantage at the lower levels. These results support the general conceptualization that 4 domains of the *DSM-5* alternative PD model traits are maladaptive, extreme versions of the FFM.

Keywords: personality, personality disorder, PID-5, FFM, Section III, alternative personality disorder model

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The official classification of personality disorders (PDs), and almost all mental disorders, over the last 30 years has been as putatively categorical constructs that are distinct from each other and from normative functioning (American Psychiatric Association, 2013). Although these traditional PD categories still have supporters (e.g., Black, 2013; Gunderson, 2013; Shedler et al., 2010), a large contingent of the PD field has recognized significant flaws of the categorical nosology and suggested that dimensional representations would relieve many of these limitations (Clark, 2007; Krueger & Eaton, 2010; Samuel & Griffin, in press; Trull & Durrett, 2005).

One prominent alternative is to consider PDs as maladaptive, extreme variants within the same five broad trait domains that

define normal personality functioning (Widiger & Trull, 2007). The five-factor model (FFM) has emerged as a compelling framework for organizing personality traits and has shown the ability to integrate diverse models (John, Naumann, & Soto, 2008). The FFM's five domains are bipolar in that constructs define conceptually opposing poles at either end of the continuum.¹ These domains are neuroticism versus emotional stability, extraversion versus detachment, openness versus closedness to experience, agreeableness versus antagonism, and conscientiousness versus disinhibition. Although alternatives exist, the FFM is widely used and has extensive empirical support for its utility across many domains of psychology, including development (Caspi, Roberts, & Shiner, 2005), behavioral health (Deary, Weiss, & Batty, 2010), and industrial/organizational (Barrick, Mount, & Judge, 2001). In addition, the FFM has support including universality across cultures (McCrae & Terracciano, 2005), heritability (Yamagata et al., 2006) and sizable test–retest correlations over several years (Fer-

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¹ The FFM constructs are bipolar in that the possible scores range from a lot of one construct (e.g., extraversion) to a lot of its opposite (e.g., introversion) and form relatively normal distributions. This contrasts with unipolar scales, on which scores range from a complete absence of something to a great deal of it and thus typically obtain comparatively more skewed distributions.

guson, 2010). These five domains have also displayed consistent and largely predictable links to diverse mental disorders (not only PDs, but also others such as anxiety and mood disorders; Kotov, Gamez, Schmidt, & Watson, 2010; Samuel & Widiger, 2008). The FFM also evinces meaningful associations with many important life outcomes (Mullins-Sweatt & Widiger, 2010; Ozer & Benet-Martinez, 2006). A number of these outcomes are highly clinically relevant, including subjective well-being, relationship quality, criminality, occupational satisfaction, physical health, and mortality (Widiger & Presnall, 2013).

Recognizing the clinical relevance of the FFM, Section III of the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5; i.e., Emerging Measures and Models)* provides an alternative, hybrid PD model that includes identification of impairments in self and interpersonal functioning as well as maladaptive traits that capture specific aspects of personality pathology. That *DSM-5* alternative PD model consists of 25 pathological traits that are organized into five broad domains of negative affectivity (vs. emotional stability), detachment (vs. extraversion), psychoticism (vs. lucidity), antagonism (vs. agreeableness), and disinhibition (vs. conscientiousness). As is obvious from their labels and organizations, the *DSM-5* alternative PD model traits bear a strong resemblance to the general FFM as well as the five broad factors of the Personality and Psychopathology–Five (Harkness & McNulty, 1994).

As such, research that investigates the similarities between the pathological traits included in the *DSM-5* alternative PD model and general personality traits, such as those delineated in the FFM, would be highly informative to decisions on how to conceptualize PDs in future editions of the diagnostic manual. In particular, research that demonstrates an empirical link between the *DSM-5* alternative PD model traits and the existing FFM operationalizations would indicate that the vast basic science literature on the FFM supports the *DSM-5* alternative PD model; potentially allaying concerns about inadequate scientific foundation of the pathological traits. In the present study, we explore whether the Section III traits (a) can be fit along the same unidimensional latent traits as normative markers of the FFM and (b) whether the *DSM-5* alternative PD model traits provide more information at the extreme, maladaptive levels of those shared latent dimensions.

DSM-5 Alternative PD Model Traits as the FFM

The origins of the *DSM-5* alternative PD model traits are described elsewhere (Krueger, Derringer, Markon, Watson, & Skodol, 2012), but some basic details are relevant as a backdrop. Specifically, the trait model was developed from the ground up, with the intention of comprehensively capturing the universe of personality pathology rather than explicitly reproducing any a priori structure (i.e., the FFM). A set of six candidate domains (negative affectivity, detachment, antagonism, psychoticism, disinhibition, and compulsivity) were developed conceptually and Personality and Personality Disorders Work Group members nominated potential lower-order trait constructs within these broad domains that would account reasonably for the universe of personality pathology (including that encoded within the *DSM-IV* PDs). The resulting 37 trait facets were operationalized in self-report items that were refined iteratively via factor analysis and item-response theory (IRT). The analyses indicated that the list of

37 traits could be collapsed into 25 traits. These 25 trait scales were comprised of four to 14 items, for a total of 220 items on a self-report measure labeled the Personality Inventory for *DSM-5* (PID-5; Krueger et al., 2012). Subsequent research has suggested that a five-factor solution for the PID-5, with the domains of compulsivity and disinhibition loaded as polar opposites on the same domain, was most tenable (Krueger et al., 2012).

A rapidly expanding literature has suggested that the PID-5 adequately captures the traditional PD categories in both undergraduate (Hopwood, Thomas, Markon, Wright, & Krueger, 2012) and clinical samples (Few et al., 2013) using a number of effective scoring methods (Samuel, Hopwood, Krueger, Thomas, & Ruggero, 2013). These results provide compelling evidence that the PID-5 can account for the variance in traditional PD constructs and, moreover, that the PID-5 domains relate in expected ways with existing measures of the FFM (Gore & Widiger, 2013).

Several researchers have utilized exploratory factor analysis to examine the joint structure of the PID-5 and various measures of general personality. Although one study suggested the possibility of joint factors beyond five using procrustean methods (Ashton, Lee, de Vries, Hendrickse, & Born, 2012), the vast majority have located five common domains in community (Griffin & Samuel, 2014) and clinical samples (Wright & Simms, 2014) that correspond closely to the FFM (for a recent review, see Krueger & Markon, 2014).

In sum, the traits within the *DSM-5* alternative PD model share a structural similarity with measures of normative personality traits developed to assess the FFM. Nonetheless, it is not yet known whether the *DSM-5* alternative PD model traits represent maladaptive *extreme* variants of the same traits, consistent with FFM theory (Widiger & Trull, 2007). Missing from the current literature is a direct investigation of this dimensional hypothesis, using IRT analyses as a method for integrating these alternative measures.

Testing the Dimensional Hypothesis Using IRT

IRT and the associated analyses contrast from classical test theory by focusing on latent properties of items, rather than observed scores (Embretson & Reise, 2000). IRT analyses rest upon the assumption that the set of indicators being examined form a shared latent continuum that is essentially unidimensional (Stout, 1990). Once this has been established, IRT analyses estimate how much psychometric information each indicator provides about the latent trait. Within two parameter models, this produces parameters *alpha* and *beta*. Alpha corresponds to the indicator's ability to discriminate between individuals and is also referred to as the slope or discrimination parameter. Alpha can be analogized to the indicator's factor loading. Beta corresponds to the level of the latent trait that is required for an individual to endorse a given response with a 50% probability. Beta is often analogized as the item's difficulty, but within personality and psychopathology assessment, it might more accurately be referred to as extremity or location. An additional product of IRT analyses that is central to the present study is the information curve that specifies the ability of indicators to provide psychometric information along the continuum of the latent trait.

Four previously published studies have utilized these properties of IRT to compare and contrast the information provided

by instruments assessing personality and PDs (Samuel, Carroll, Rounsaville, & Ball, 2013; Samuel, Simms, Clark, Livesley, & Widiger, 2010; Stepp et al., 2012; Walton, Roberts, Krueger, Blonigen, & Hicks, 2008). All of these studies have supported the dimensional hypothesis that personality pathology represents a maladaptive, extreme variant of normal personality traits. Walton and colleagues (2008) compared indices specifically for the PD construct of psychopathy, whereas Samuel, Carroll, and colleagues (2013) focused exclusively on borderline PD. Stepp and colleagues (2012) demonstrated that individual scales from the NEO Personality Inventory–Revised (NEO PI–R), the Schedule for Nonadaptive and Adaptive Personality-2 (SNAP-2), and the Temperament and Character Inventory could be integrated into five higher-order domains, with specific measurement strengths of each instrument. Samuel and colleagues (2010) provided a broader analysis when they compared the information provided by the predominant self-report measure of the FFM, the NEO PI–R (Costa & McCrae, 2010), to two measures of maladaptive personality traits: the Dimensional Assessment of Personality Pathology (DAPP-BQ; Livesley & Jackson, 2009) and the SNAP-2 (Clark, Simms, Wu, & Casillas, 2014).

In that study, Samuel and colleagues sorted the adaptive and maladaptive trait into higher order domains on the basis of prior factor analytic research and then conducted IRT analyses. After removing poorly loading items, they found that a unidimensional model fit well for each putative domain. Further, they concluded that although the normal and maladaptive instruments exhibited large overlap, the SNAP-2 and DAPP-BQ provided more information at the uppermost levels of the shared traits, whereas the NEO PI–R provided more at the lower levels. This research provided important evidence supporting the claim that those two models of personality pathology were maladaptive extensions of the FFM. Nonetheless, both the DAPP-BQ and SNAP-2 models differ in important ways from the trait model included in *DSM-5*. Thus it would be particularly important to replicate and extend these prior findings by comparing the *DSM-5* alternative PD model traits to those from a traditional measure of the FFM using IRT analyses.

The present study fills this gap in the literature by comparing the PID-5 and the IPIP–NEO (Goldberg et al., 2006), which is a freely available broadband measure of the FFM as operationalized by Costa and McCrae (2010) in the NEO PI–R, within a large combined sample. We offer two specific hypotheses: First, based on existing factor analytic evidence, we hypothesize that the facet scales from these two measures can be arranged within the five broad domains that are essentially unidimensional (Stout, 1990). Importantly, we chose to make this comparison using the domains, calculated as aggregates of the facets, because domains represent the level of the hierarchy that are hypothesized to be similar across the measures. Second, we hypothesize that the mean information curves for the PID-5 and the IPIP–NEO domains will evince meaningful differences in terms of their locations along the shared latent traits. More specifically, the PID-5 will provide more information at the uppermost levels, while the IPIP–NEO will offer more measurement precision at the lower levels of these shared latent traits.

Method

Measures

Personality Inventory for *DSM-5* (PID-5). The PID-5 is a 220-item self-report measure of the *DSM-5* alternative PD model traits (Krueger et al., 2012). The PID-5 measures 25 traits that can be organized into five overarching domains (i.e., negative affectivity vs. emotional stability, detachment vs. extraversion, psychoticism vs. lucidity, antagonism vs. agreeableness, and disinhibition vs. conscientiousness). Each trait is assessed by four to 14 items and facet internal consistencies (alphas) in the current dataset ranged from .68 to .96 (Supplemental Materials Table A). The PID-5 is freely available and can be obtained from <http://www.psychiatry.org/practice/dsm/dsm5/online-assessment-measures#Personality>.

International Personality Items Pool–NEO PI–R (IPIP–NEO). IPIP–NEO (Goldberg et al., 2006) is a 300-item self-report measure of the FFM. The IPIP–NEO measures the five domains (i.e., neuroticism vs. emotional stability, extraversion vs. introversion, openness vs. closedness to experience, agreeableness vs. antagonism, and conscientiousness vs. disinhibition), each of which has six underlying facets. Each facet is assessed by 10 items and facet internal consistencies ranged from .66 to .88 (Supplemental Materials Table A). The IPIP–NEO is freely available and can be obtained from <http://ipip.ori.org/newMultipleconstructs.htm>.

Validity items. Four items assessing statements unlikely to be endorsed by honestly responding participants were interspersed within the two measures. The items were “I have never seen a tree,” “I was born on the moon,” “I have three arms,” and “I have never used a phone.”

Scoring of measures. For consistency between measures, all items were rated on a scale of 1 (*very false or often false*) to 4 (*very true or often true*), which is different from the original IPIP–NEO scaling. For each facet, if there was at least one item completed, the average of all items that constituted the facet was calculated. The average scores of facets were converted to integers for IRT analyses. We considered carefully how to make this transformation. Standard rounding procedures would create unequal bands that artificially pushed respondents into the middle two response categories (i.e., 1 and 4 would draw from bands that included approximately .50 score units, while 2 and 3 would draw from bands of 1.00 score units). Thus, we employed a metric that gave four possible scores in equal intervals. Specifically, the final facet scores for each individual were calculated so that the average score between 1 and 1.74 equaled 1, between 1.75 and 2.49 equaled 2, between 2.5 and 3.24 equaled 3, and between 3.25 and 4 equaled 4.² IPIP–NEO facets were scored to match the PID-5 direction, as necessary (e.g., IPIP–NEO extraversion facets were scored to match the direction of PID-5 detachment).

² At the request of a reviewer, we rounded the integers using the conventional method (i.e., $<.50 = 0$; $\geq.50 = 1$) and found that this did not impact the findings in an appreciable way. We believe the equal intervals are the most accurate representation of the data so retained this strategy. These results are available upon request from the first author.

Samples and Procedures

The present study combined two groups of participants recruited from community and undergraduate populations. The Minnesota Twin Registry is a birth-record based twin registry including intact surviving pairs born between 1936 and 1955 in the state of Minnesota. For more information related to the Minnesota Twin Registry's original recruitment procedures, see Lykken, Bouchard, McGue, and Tellegen (1990). Participants were included in this study if they were members of intact pairs and had previously provided demographic and personality information. Removing broken pairs on both assessments (pairs in which only one of the twins provided information), deceased, and withdrawn participants resulted in a target sample of $N = 3,992$ (1,996 pairs). Data collection started near the end of 2011 and participants first had the opportunity to complete the survey online. After 3 months, and three e-mail prompts to respond online, participants were mailed a paper copy of the survey. All participants received at least one call prompt and were mailed an additional copy of the survey, if requested. The data collection period ended after 10 months, and from the total possible sample, 56% ($N = 2,237$) participated.

Undergraduate students were recruited from the University of Minnesota's Research Experience Program, offered through the psychology department. Students could choose from a variety of available studies, and would receive Research Experience Program points in return for their time. This project was available only online and students were awarded extra credit for their participation. The PID-5 and IPIP-NEO were exactly the same between the undergraduate and the twin community sample and participants were expected to spend 60–90 min to complete the survey. The collection period for the undergraduate sample covered 3 semesters (Fall 2011, Spring 2012, and Summer 2012). If the assessment was left incomplete, e-mail prompts were sent to the student. After the collection period ended, the total sample recruited consisted of 1,830 participants.

Of the 4,067 participants in the combined sample, we removed the 550 individuals who endorsed any answer other than *very false* on any of the validity items (including 79 who did not answer the validity items). This yielded a final sample of 3,517 participants (1,941 community twins; 55.2%). Missing data were imputed using the default FIML procedure within Mplus. The sample ranged from 18 to 76 years old and the mean age was 44.4 years old. The majority of the sample was female (66.4%) and European American (92.7%), with other ethnic groups being 4.4% Asian, 1.5% African American, 0.2% Native American, and 1.1% other/mixed.

Data Analyses and Results

Facet Selections and Assessment of Unidimensionality

A fundamental assumption of IRT is that the indicators form an essentially unidimensional latent construct. Stout (1990) has defined this as the presence of one major factor, not the absence of any subfactors. There are a number of different methods for examining unidimensionality, but this typically proceeds within a factor analytic framework that yields absolute fit indices for a one-factor solution. As a preliminary step in our analyses, we calculated the matrix of correlations of the PID-5 and IPIP-NEO

scales, which is available in Supplemental Materials Table B. We then organized the 55 facets (25 PID-5 and 30 IPIP-NEO) into the five broad domains that have been specified by theory and prior joint factor analyses. For the IPIP-NEO, the facets are all explicitly linked to a specific domain, whereas the PID-5 contains interstitial facets that are cross-listed on two domains within the text of *DSM-5*. Thus, for the first stage of analyses we allowed the PID-5 facets of depressivity, restricted affectivity, and suspiciousness to organize on negative affectivity and detachment. Similarly, the PID-5 facet of hostility was included in both negative affectivity and antagonism.

The set of indicators for each domain were subjected to confirmatory factor analysis in an exploratory structural equation modeling framework. All analyses were conducted in Mplus version 7.20 (Muthén & Muthén, 1998–2012), and default settings were used (e.g., weighted least squares estimator), unless otherwise specified. All facet scores were treated as ordinal indicators and the twins within each pair were treated as clustered observations. This software outputs three fit indices that we utilized for determining unidimensionality. The Comparative Fit Index (CFI) and Tucker–Lewis Index (TLI) both range from 0 to 1, with values above .95 and .90 indicating close and acceptable fits, respectively (Hu & Bentler, 1999). Root mean squared error of approximation (RMSEA) is a chi-squared-based index of model fit. There is no hard and fast interpretation guideline for RMSEA, but generally values $< .08$ are considered indicative of reasonable fit, and those $< .10$ are often considered adequate (MacCallum, Browne, & Sugawara, 1996).

Guided by these thresholds, we iteratively purified the initial facets within each domain in a way that balanced fidelity of construct with the requirement of essential unidimensionality. As our empirical focus was a comparison of the broad domains, we sought to retain as much variance within each instrument so that the construct we analyzed had high fidelity with the typical use of these measures. In this vein, putatively interstitial facets that loaded poorly on their primary domain were removed and tried in a second domain. For example, PID-5 rigid perfectionism obtained a superior fit on negative affectivity even though it sometimes loads on disinhibition in joint analyses (e.g., Griffin & Samuel, 2014). Similarly, the facet of immoderation (alternatively titled impulsivity) from the IPIP-NEO is assigned to neuroticism, but obtained a better fit within the disinhibition domain. Ultimately, though, there were scales from each measure that did not load sufficiently on any joint domain and were excluded from the final analyses. Specifically, the PID-5 facet of submissiveness and the IPIP-NEO facets of activity and excitement-seeking, as well as five of the IPIP-NEO openness scales were not retained. Finally, based on their relative loadings on each domain, the interstitial PID-5 facets of depressivity, hostility, and suspiciousness were retained on negative affectivity, while the PID-5 facet of restricted affectivity was retained on detachment.

Table 1 presents the final list of facets that comprised each domain as well as the fit indices of the final one-factor models. The resulting five domains were deemed essentially unidimensional as evidenced by CFI and TLI values $> .92$ and RMSEAs that ranged from .07 to .10. The combined domain of disinhibition and conscientiousness obtained the weakest fit, particularly by RMSEA, but the CFI (.94) and TLI (.92) were acceptable and further facet removals did not improve the fit. Thus, all five domains were

Table 1
PID-5 and IPIP-NEO Domain Pairs, Final Facet List of Each Pair, and Fit Indices for Each Pair

Domains and facets		Fit indices		
PID-5	IPIP-NEO	RMSEA	CFI	TLI
Negative affect Anxiousness Depressivity Emotional lability Hostility Perseveration Separation insecurity Suspiciousness Rigid perfectionism	Neuroticism Anxiety Anger Depression Self-consciousness Vulnerability	0.08	0.97	0.96
Detachment Anhedonia Intimacy avoidance Restricted affectivity Withdrawal	Extraversion Friendliness Gregariousness Assertiveness Cheerfulness	0.09	0.97	0.95
Antagonism Attention-seeking Callousness Deceitfulness Grandiosity Manipulativeness	Agreeableness Trust Morality Altruism Cooperation Modesty Sympathy	0.09	0.95	0.93
Disinhibition Distractibility Impulsivity Irresponsibility Risk-taking	Conscientiousness Self-efficacy Orderliness Dutifulness Achievement-striving Self-discipline Cautiousness Immoderation	0.10	0.94	0.92
Psychoticism Eccentricity Perceptual dysregulation Unusual beliefs and experiences	Openness to experience Imagination	0.07	0.99	0.97

Note. PID-5 = Personality Inventory for the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition*; IPIP-NEO = International Personality Item Pool-NEO; RMSEA = root mean square error of approximation; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index.

deemed suitable for IRT analyses. Nonetheless, as noted above, the openness-psychoticism domain only reached unidimensionality after five of the six facets from the IPIP-NEO were eliminated, thus the resulting comparison likely differs from the typical operationalization of openness to experience.

Item Response Theory Analyses

IRT parameters were drawn directly from the output from the best-fitting model in Mplus and, because the indicator variables were polytomous, these parameters correspond with Samejima's graded response model (Samejima, 1970). Figure 1 presents each domain's test information curves, which were calculated by averaging the information curves for the facets within each instrument. The primary hypotheses were in regard to the comparison between instruments, so we focus on the average curves for the facets within each instrument, although information curves for each individual scale are available in Supplemental Materials Figure A. These test information curves indicate where the PID-5 and IPIP-

NEO provide information about each of the latent traits. As can be seen from the peaks for four of the five domain curves, the PID-5 and IPIP-NEO measurements generally provide similar amounts of information relevant to the latent construct. The exception was the psychoticism and openness domain, where it was clear that the three PID-5 facets defined the joint domain much more strongly than the single IPIP-NEO facet openness to imagination. The figures also indicate that PID-5 domains generally provided more information specifically at the upper, more extreme level than the IPIP-NEO domains. In contrast, the IPIP-NEO domains provide more information at the lower levels of the traits than PID-5 domains. This finding was not as clear for the domains of antagonism and disinhibition, as the IPIP-NEO curve showed a slight advantage at the lowest and highest levels of the joint traits. Overall, though, these findings suggest the two instruments, although highly similar in coverage, do differ in terms of their measurement precision at specific levels of the joint domains.

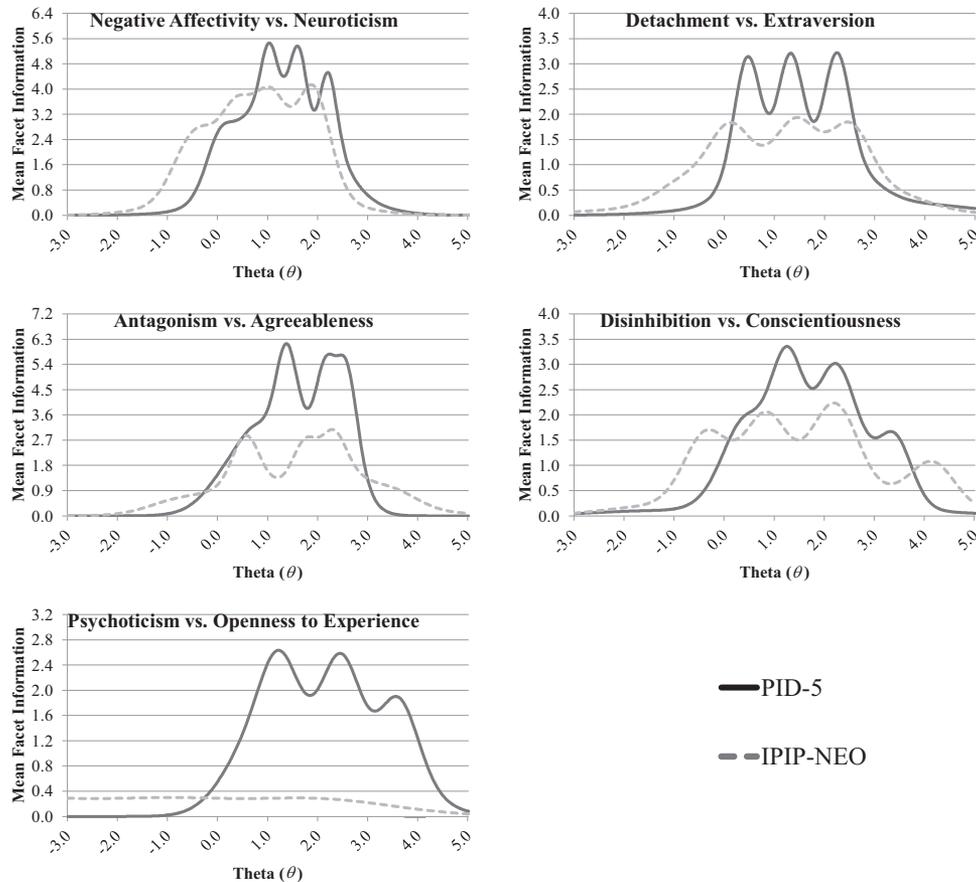


Figure 1. PID-5 and IPIP-NEO mean information curves for each domain pair. PID-5 = Personality Inventory for the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition*; IPIP-NEO = International Personality Item Pool-NEO.

The alpha and beta parameters for each facet within its respective domain are presented in Table 2. There is no test of statistical significance between these values that is sensitive to sample size, so we followed the method employed in our prior studies (e.g., Samuel, Carroll, et al., 2013). Specifically, we compared the alpha and beta parameters across the two instruments in terms of Cohen's d and utilized Cohen's (1992) guidelines for interpreting effect sizes (i.e., .20, .50, and .80 are small, medium, and large, respectively). According to this guideline, most differences in alpha parameters between the two measures were small, suggesting that the two measures do not differ in their abilities to assess the latent construct. One exception was the large difference between alpha values on the antagonism domain. The differences between the first beta parameters of the measures were generally quite large. This would suggest that higher trait levels were necessary to endorse the second lowest option of PID-5 than for the IPIP-NEO. This indicates that the lower two options of the PID-5 tap higher trait level than those from the IPIP-NEO. For the second and third beta parameters, the results are mixed. For the second beta parameters (i.e., the threshold for choosing the third option over the second option) of the negative affectivity and detachment domains, the PID-5 had higher beta parameters than the IPIP-

NEO and the differences were large. For the third beta parameter, the large differences for these two domains diminished to medium and small, respectively. This suggests that the jump for the third to the fourth (i.e., most extreme) response on both measures required less difference in trait levels than the other two response intervals. Although the Cohen's d scores were not calculated for the psychoticism domain, a visual examination of the differences suggested a similar pattern.

It is worth pointing out that the results were notably different for the antagonism domain (and disinhibition to a lesser magnitude). Although the first beta parameter suggested that the endorsement of the PID-5 items required higher levels of the trait, the second and third beta parameters reversed direction such that the IPIP-NEO was higher than the PID-5. This suggests that a higher trait level was required to endorse the highest IPIP-NEO options than their PID-5 counterparts. A smaller, but similar pattern emerged for the disinhibition domain, with the PID-5 and IPIP-NEO requiring comparable trait level to endorse higher two options. These results echo the subtle, but potentially important differences in the curves for the antagonism and disinhibition domains, where it appeared the IPIP-NEO provided more information at the very uppermost ends (i.e., $\theta > 3.5$).

Table 2
The Alpha and Beta Parameters of Each Facet Within Its Respective Domain Pair

Domains and facets	a	b1	b2	b3
Negative affect vs. neuroticism				
PID: Anxiousness	3.34	0.01	0.67	1.36
PID: Depressivity	5.06	1.01	1.62	2.19
PID: Emotional lability	2.00	0.34	1.09	1.75
PID: Hostility	2.43	0.40	1.39	2.26
PID: Perseveration	2.22	0.21	1.21	2.39
PID: Separation insecurity	1.35	0.43	1.36	2.16
PID: Suspiciousness	1.42	0.46	1.71	2.82
PID: Rigid perfectionism	1.01	-0.12	1.11	2.27
IPIP: Anxiety	2.51	-0.67	0.52	1.53
IPIP: Anger	1.96	-0.31	0.84	1.89
IPIP: Depression	3.04	0.29	1.11	1.91
IPIP: Self-consciousness	1.20	-0.98	0.64	2.44
IPIP: Vulnerability	2.61	-0.27	0.87	1.97
PID mean (<i>SD</i>)	2.35 (1.32)	0.34 (0.34)	1.27 (0.33)	2.15 (0.43)
IPIP mean (<i>SD</i>)	2.26 (0.71)	-0.39 (0.48)	0.80 (0.23)	1.95 (0.32)
Cohen's <i>d</i>	0.08	1.84	1.60	0.50
Detachment vs. extraversion				
PID: Anhedonia	1.67	0.57	1.59	2.55
PID: Intimacy avoidance	0.75	1.08	2.30	3.76
PID: Restricted affectivity	0.69	0.35	2.09	3.84
PID: Withdrawal	3.38	0.45	1.31	2.23
IPIP: Friendliness	2.27	0.08	1.41	2.54
IPIP: Gregariousness	1.55	-0.79	0.79	2.00
IPIP: Assertiveness	0.72	-1.84	0.96	3.21
IPIP: Cheerfulness	1.26	0.12	1.90	3.28
PID mean (<i>SD</i>)	1.62 (1.26)	0.61 (0.32)	1.82 (0.45)	3.09 (0.82)
IPIP mean (<i>SD</i>)	1.45 (0.65)	-0.61 (0.92)	1.26 (0.50)	>2.76 (0.60)
Cohen's <i>d</i>	0.17	1.76	1.17	0.47
Antagonism vs. agreeableness				
PID: Attention-seeking	1.66	0.07	1.03	2.09
PID: Callousness	4.22	1.36	2.15	2.56
PID: Deceitfulness	2.76	0.74	1.49	2.52
PID: Grandiosity	2.03	0.63	1.50	2.42
PID: Manipulativeness	2.19	0.22	1.12	1.98
IPIP: Trust	0.88	0.03	2.34	4.14
IPIP: Morality	3.47	0.55	1.75	2.29
IPIP: Altruism	1.83	0.70	2.54	3.57
IPIP: Cooperation	1.49	0.16	1.76	3.00
IPIP: Modesty	1.55	-0.91	0.96	2.35
IPIP: Sympathy	1.27	-0.19	1.82	2.92
PID mean (<i>SD</i>)	2.57 (1.00)	0.60 (0.50)	1.46 (0.44)	2.31 (0.26)
IPIP mean (<i>SD</i>)	1.75 (0.90)	0.06 (0.58)	1.86 (0.55)	3.04 (0.71)
Cohen's <i>d</i>	0.87	1.00	-0.79	-1.30
Disinhibition vs. conscientiousness				
PID: Distractibility	1.82	0.24	1.18	2.26
PID: Impulsivity	2.28	0.42	1.27	2.48
PID: Irresponsibility	2.61	1.24	2.10	3.39
PID: Risk taking	0.70	-1.37	1.25	3.52
IPIP: Self-efficacy	1.55	0.07	2.16	3.80
IPIP: Orderliness	0.97	-0.49	1.56	2.94
IPIP: Dutifulness	2.21	0.75	2.35	4.19
IPIP: Achievement-striving	1.36	0.01	1.96	4.25
IPIP: Self-discipline	2.24	-0.40	0.83	1.96
IPIP: Cautiousness	2.02	-0.44	1.09	2.32
IPIP: Immoderation	1.05	-1.81	0.30	2.34
PID mean (<i>SD</i>)	1.85 (0.84)	0.13 (1.09)	1.45 (0.43)	2.91 (0.63)
IPIP mean (<i>SD</i>)	1.63 (0.53)	-0.33 (0.78)	1.46 (0.76)	3.11 (0.96)
Cohen's <i>d</i>	0.35	0.51	-0.02	-0.23
Psychoticism vs. openness to experience				
PID: Eccentricity	1.63	0.58	1.40	2.42
PID: Perceptual dysregulation	2.25	1.20	2.46	3.60
PID: Unusual beliefs and experiences	1.20	1.10	2.38	3.63

(table continues)

Table 2 (continued)

Domains and facets	a	b1	b2	b3
IPIP: Imagination	0.58	-3.84	-0.96	1.93
PID mean (SD)	1.69 (0.53)	0.96 (0.33)	2.08 (0.59)	3.22 (0.69)
IPIP mean	0.58	-3.84	-0.96	1.93

Note. a = alpha parameter; b1, b2, and b3 = 1st, 2nd, and 3rd beta parameters, respectively; PID = Personality Inventory for the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition*; IPIP = International Personality Item Pool-NEO; SD = standard deviation.

Discussion

A broad literature indicates that PDs can be described as maladaptive trait combinations and that these maladaptive traits represent variants of those that define general personality. The present study extends prior work by indicating support for the view that most facets from four domains of the PID-5 and the IPIP-NEO can be sorted into joint domains that are essentially unidimensional. These results build upon the expanding literature indicating that the traits assessed by the PID-5 share a common, hierarchical structure with measures designed to assess normative traits (Krueger & Markon, 2014). The exception was that the pathological domain of psychoticism and the normative domain of openness could not comfortably be fit onto a common factor. This finding reflects the inconsistency of their joint analyses in the literature as a number of studies have shown they can be fit onto a joint factor (De Fruyt et al., 2013; Thomas et al., 2013), while others have been more equivocal (Ashton et al., 2012) or shown that only specific facets of openness, particularly fantasy and ideas, load with PID-5 psychoticism (Griffin & Samuel, 2014; Wright & Simms, 2014).

IRT analyses demonstrated that the facets from the remaining four domains of the PID-5 and the IPIP-NEO not only could be fit along shared latent dimensions, but that the measures provided mostly overlapping information along those dimensions. Both the PID-5 and IPIP-NEO provided psychometric information across a broad range of the latent trait. Nonetheless, the measures were not completely redundant and differences that emerged were mostly consistent with their design and development. The PID-5 typically offered an advantage at the upper (maladaptive) levels, whereas the IPIP-NEO provided more psychometric information at the lower (adaptive) levels of the traits, although there were exceptions for the highest response options on antagonism and disinhibition from the IPIP-NEO. Overall, the results support the broad conclusion that the dimensional traits included within *DSM-5* alternative PD model represent maladaptive, extreme variants of at least four of the same traits that define normal personality. In other words, except for openness/psychoticism, both the PID-5 and the IPIP-NEO are complimentary measures of the FFM that differ in terms of their relative strengths at specific locations of the shared traits. These relative strengths are likely directly related to the proportion of items keyed in one direction over another. The IPIP-NEO contains relatively equal numbers of items keyed toward each pole of a given domain, which is reflected in its relatively equal precision at high and low levels. In contrast, the PID-5 items are predominantly scored in one direction, likely yielding greater precision at those levels. In sum, a primary implication of this finding is that the vast array of basic science support for the FFM (John et al., 2008) is applicable to Criterion B of the *DSM-5* alternative PD model. Thus, our results suggest

the alternative PD model traits have among the highest levels of empirical support across the *DSM-5*.

Practically, the large overlap between the PID-5 and IPIP-NEO suggests that both of these measures do an admirable job at covering broad ranges of the shared domains. The PID-5 appears, despite its development as a measure of abnormal personality, to extend its assessment into ranges that are typically covered by normative inventories, except for openness to experience. Similarly, despite its development as a measure of normative personality, the IPIP-NEO captures the maladaptive range of these traits, consistent with past research (Miller et al., 2008; Trull, Widiger, Lynam, & Costa, 2003).

It is important to note that our points of comparison were the values for the five domains, as aggregated by the facets that underlie them. The decision to investigate at the domain level of the hierarchy is consistent with past research (e.g., Samuel et al., 2010) and represents the most direct way of testing the broad, theoretical link between the *DSM-5* alternative PD model traits and those from traditional markers of the FFM. Nonetheless, it does come with tradeoffs. Specifically, the domains we measured here represent aggregates of highly related, but conceptually distinct, facets. Although the domains ultimately evinced essential unidimensionality, they represent the common variance shared by the facets that complicate our analyses with inherent heterogeneity (e.g., Smith, McCarthy, & Zapsolski, 2009). In this way, certain facets that are more central to the shared latent dimension will be favored. This was clearly borne out in the alpha parameter estimates (which are simply transformations of the confirmatory factor analysis factor loadings) in Table 2. For example, IPIP-NEO trust and PID-5 risk taking obtained lower loadings than the other facets on the joint agreeableness/antagonism and conscientiousness/disinhibition domains, respectively. In this way, the latent domains inherently shift based on the commonality of the facets. This likely explains much of the difficulty with openness and psychoticism, as the three PID-5 facets were more homogenous with each other, than were the six facets within the IPIP-NEO, resulting in a domain that skewed heavily toward the PID-5 content. Thus, our particular findings may reflect areas of density within the specific facet indicators included in the measures as much they do the underlying latent constructs (Borsboom, Mellenbergh, & van Heerden, 2004; Smith, 2005).

An alternative approach would have been to focus on the most basic units of analysis and compare specific pairs of facets from each instrument, calculated as aggregates of the items within the scales. For example, one could directly compare IPIP-NEO anxiousness to PID-5 anxiety, IPIP-NEO modesty to PID-5 grandiosity, or IPIP-NEO cautiousness with PID-5 risk-taking. Nonetheless, because there is not necessarily a one-to-one correspondence between all the facets

across these measures, such a strategy would result in a narrow comparison of specific scales, rather than broad comparison of two instruments. Future research that employs these differing approaches, with a variety of measures, and across diverse samples, will be highly valuable in extending our present findings.

The Perpetually Problematic Fifth Domain

Evidence for continuity emerged across the five domains, although there were two for which the support was less robust. The joint domain of openness/psychoticism did evince unidimensionality, but this required the removal of five IPIP-NEO facets of openness, such that only imagination remained. Nonetheless, the fit between this facet and the three traits of psychoticism from the PID-5 was less than ideal. As noted by the alpha parameters, the PID-5 traits predominantly defined this latent dimension. On the one hand, such a finding for the domain of openness is not surprising (Edmundson, Lynam, Miller, Gore, & Widiger, 2011; Piedmont, Sherman, & Sherman, 2012; Samuel & Widiger, 2008). Although a number of studies have suggested links between openness and maladaptive traits with labels such as schizotypy, oddity, peculiarity, or psychoticism (e.g., Edmundson et al., 2011; Kwapil, Barrantes-Vidal, & Silvia, 2008; Wiggins & Pincus, 1989) others have suggested no appreciable overlap (Quilty, Ayearst, Chmielewski, Pollock, & Bagby, 2013; Watson, Clark, & Chmielewski, 2008).

Research findings have indicated that both of these seemingly opposite conclusions may be accurate, depending on the specific measurements utilized (DeYoung, Grazioplene, & Peterson, 2012). In fact, the relationship may differ among facets *within* the domain (Chmielewski, Bagby, Markon, Ring, & Ryder, 2014; Samuel & Widiger, 2008). There has long been a connection between intelligence and openness to experience, which is explicitly labeled intellect within the Big Five. Specifically, Chmielewski and colleagues (2014) found that the NEO PI-R facet of openness to fantasy (i.e., imagination from the IPIP-NEO) related positively to PID-5 psychoticism, while other facets within the domain had no relationship, or even trended negatively. This echoes meta-analyses which have shown some specificity within the facets of openness (Samuel & Widiger, 2008) and studies that have shown the magnitude differs dramatically across specific conceptualizations of openness (Haigler & Widiger, 2001).

DeYoung and colleagues (2012) provided a potentially useful framework for understanding the complex link by positioning these constructs along a simplex dimension. A simplex represents a dimension along which constructs can be arrayed with those most proximal to each other being the most similar, and those most distal being most different. DeYoung and his colleagues hypothesized that a simplex structure, with intelligence at one end, openness in the middle, and positive schizotypy on the other might help to explain the specific relationships observed between openness/intellect and psychoticism across studies. Such a model provides an intriguing set of testable hypotheses that might help conceptualize this fifth domain.

In any event, it is clear that the choice of specific instruments for operationalizing openness and psychoticism will determine the direction and magnitude of this link. This way, the IPIP-NEO does not represent an ideal choice for testing this hypothesis as it focuses mostly on the adaptive ranges of openness without ade-

quate representation of the pathological extremes (Haigler & Widiger, 2001). Conversely, the PID-5 appears to focus on particularly pathological variants of psychoticism. In sum, future work that undertakes similar analyses with alternate measures of openness and psychoticism appear likely to reach different conclusions and it will be interesting to determine how well these normative and pathological variants can be captured within a single measure. Such a middle ground also appeals to parsimony as it would be quite odd for pathological and normative to share four overlapping domains, yet each has a fifth component with no appreciable link in the other system (Widiger & Presnall, 2013).

A second, partial departure from our hypotheses was for the domains of antagonism and disinhibition. For these domains, the IPIP-NEO and PID-5 test information curves showed less overlap, with the IPIP-NEO curve appearing higher at the lower and *upper regions*. In fact, the comparison of beta parameters even suggested that a higher level of the latent trait was required to endorse the top responses to items on the IPIP-NEO than the PID-5—opposite of most other domains. Although, this is somewhat surprising given the development of the IPIP-NEO was explicitly focused on the normative range of these traits, it suggests that particularly low scores on these facets of agreeableness are equivalent or even more extreme than high levels of antagonism, for example.

Such a framework implicitly rests on the bipolarity hypothesis that these constructs represents opposite, but equally informative, ends of the same continuum (Samuel, 2011). This bipolarity is explicitly built into the IPIP-NEO as it contains roughly equivalent numbers of positively and negatively keyed items and scale scores are reasonably normally distributed across the sample. Our finding is consistent with the success that the normative inventories have had in capturing pathologically low agreeableness and conscientiousness associated with PD constructs such as psychopathy and antisocial PD (Lynam & Widiger, 2007; Witt & Donnellan, 2008). Nonetheless, it will be important to better understand whether, for example, low scores on IPIP-NEO altruism have the same meaning as high scores on PID-5 callousness.

Conceptual and Practical Implications

A broad conceptual implication of this work is further evidence that four of the *DSM-5* alternative PD model traits are contained within the FFM (Widiger & Mullins-Sweatt, 2009). Importantly, this indicates that the broad research base on the FFM is directly relevant to the *DSM-5*. Although continued work will be crucial to bear this out, this suggests that the *DSM-5* alternative PD model traits can be expected to relate predictably to a variety of life outcomes (Hopwood et al., 2009; Ozer & Benet-Martinez, 2006) and show patterns of high temporal stability (Ferguson, 2010; Roberts & DelVecchio, 2000), for example. Such a link suggests the extant FFM literature should support its formal adoption in future editions of the DSM.

Practically, our findings suggest that both the PID-5 and IPIP-NEO are able to cover both pathological and normative ranges of four of the joint FFM domains. However, the specific choice of one instrument over another should be governed by the priorities of that study. For example, it is likely that for questions involving presumably normative ranges of the traits, the IPIP-NEO or similar measures would be beneficial, whereas more pathological outcomes might warrant the use of the PID-5.

Future Directions

The bulk of the present effort has focused on the link between the domains that appear to unify general personality across pathological and normative instruments. Although work remains to determine the precise link between openness and psychoticism, it appears that to a large extent, there now exists a consensus at the domain level of the hierarchy (Skodol, 2014). Less consensus exists with regard to the lower-order traits, or facets, that comprise each domain and are fundamental for adequately accounting for personality pathology (Axelrod, Widiger, Trull, & Corbitt, 1997; Reynolds & Clark, 2001). In this regard, the present study's conclusions are limited by the inventories we employed. Although the choices of the PID-5 and IPIP-NEO as two freely available, broadband, faceted inventories are quite defensible, other alternatives exist. For example, if one seeks to focus only on domains one could compare the Big Five Inventory (John, Donahue, & Kentle, 1991) or the Personality Psychopathology Five (Harkness & McNulty, 1994).

At the facet level, multiple alternative structures have been proposed within both normative (e.g., Costa & McCrae, 2010; DeYoung, Quilty, & Peterson, 2007) and pathological inventories (e.g., Livesley & Jackson, 2009; Simms et al., 2011) that differ from those explored in the present study. In this regard, it is encouraging that the facets of the Computer Adaptive Test of Personality Disorders (CAT-PD; Simms et al., 2011) and the PID-5 line up reasonably well (Wright & Simms, 2014), but future work that focuses on the lower-order facets and how they overlap and increment each other across instruments will be critical. It is also conceivable that specific facets might be more relevant for the characterization of pathology and others more relevant for normative outcomes. In any event, a truly comprehensive model or measure of personality necessitates a fully articulated set of lower-order traits.

Such a model might even be tractable within the confines of a single measure that possessed high fidelity at all levels of each latent trait. As the present results suggest, existing measures do an admirable job of covering broad swaths of these joint domains, but still have relative areas of strength. A relatively novel measure, the CAT-PD, was designed to accomplish such a goal but we are not aware of IRT research which has compared the CAT-PD provision of information along the latent trait continua to that from the PID-5 and IPIP-NEO, for example.

Limitations

The present effort built upon existing studies by providing the first comparison of the trait portion of the *DSM-5* alternative PD model and the normative FFM in terms of IRT-methods to determine their overlap along the common latent traits. As such, there are limitations that might be addressed in future studies. One primary limitation is that we utilized indicators at the facet-level rather than the item-level. Such an approach had the advantage of making a clear conceptual point, but may collapse important item-level distinctions. Future work that explores the domains or facets at the item-level might be fruitful.

A second limitation is that all analyses were conducted within a sample that included community and undergraduate participants. These types of samples, particularly one as large as we employed, are thought not to be problematic for IRT analyses, which produce results that are understood to be sample independent. Nonetheless, the PID-5 was explicitly developed to assess constructs of a clinical nature, so including individuals in active psychotherapy would be valuable.

Another complication that is inherent to IRT is that it requires all items to be scored in a single direction. For example, all items from IPIP-NEO agreeableness had to be reversed to be consistent with the keying of PID-5 antagonism. This creates the situation whereby low scores on IPIP-NEO altruism items involving self-sacrifice are equated with high scores on PID-5 callousness items. Such an approach is consistent with bipolar constructs, but these are complicated issues that would benefit from additional empirical evaluation to be certain that these high versus low scores are truly equivalent.

Conclusions

The present study utilized a large, age-diverse sample to compare and contrast the *DSM-5* alternative PD model traits with extant instantiations of the general personality using IRT analyses. Results suggested these constructs could be reasonably sorted into five broad, unidimensional, domains that reflect the FFM. Further, the results provided support for the dimensional hypothesis that PD represents a maladaptive, extreme variant of the same general traits that describe normative personality functioning. This link provides explicit support for viewing four of the *DSM-5* Section III traits as an instantiation of the FFM and suggests that the wide literature of basic science on the FFM is highly relevant to the validity of the *DSM-5* alternative PD model. Although future research must continue to explore the fifth domain as well as the lower-order facets within the domains, the FFM provides an overarching framework that can be fruitfully applied to personality pathology.

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