

Evaluating the Big Five as an Organizing Framework for Commonly Used Psychological
Trait Scales

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Abstract

The Big Five is often represented as an effective taxonomy of psychological traits, yet little research has empirically examined whether stand-alone assessments of psychological traits can be located within the Big Five framework. Meanwhile, construct proliferation has created difficulty navigating the resulting landscape. In the present research, we developed criteria for assessing whether the Big Five provides a comprehensive organizing framework for psychological trait scales, and evaluated this question across three samples (Total N = 1,039). Study 1 revealed that 83% of an author-identified collection of scales (e.g., Self-Esteem, Grit, etc.) were as related to the Big Five as at least 4 of 30 Big Five facets and Study 2 found that 71% of scales selected based on citation counts passed the same criterion. Several scales had strikingly large links at the Big Five facet level, registering correlations with individual Big Five facets exceeding 0.9. We conclude that the Big Five can indeed serve as an organizing framework for a sizable majority of stand-alone psychological trait scales and that many of these scales could reasonably be labeled as facets of the Big Five. We recommend an *integrative pluralism* approach, where reliable, valid scales, are located within the Big Five and pertinent Big Five research is considered in all research using trait scales readily located within the Big Five. By adopting such an approach, construct proliferation may be abated and it would become easier to integrate findings from disparate fields.

Keywords: Big Five, stand-alone scales, construct proliferation, taxonomy

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“If you do not know the names of things, the knowledge of them is lost, too.”

— Carl Linnaeus

“A good descriptive taxonomy, as Darwin found in developing his theory, and as Newton found in the work of Kepler, is the mother of laws and theories” (Cattell, 1987, p. 61).

The development and promulgation of the Five Factor Model of personality (Costa & McCrae, 1985; McCrae & Costa, 1985) or the Big Five (Goldberg, 1990) was to be a watershed moment for psychological research. According to early promoters and adopters of the model, it represented a highly encompassing framework that could be used to capture the most salient trait-like individual differences in the psychological sphere (Goldberg, 1993; John et al., 2008). In other words, it was thought to provide a comprehensive organizing framework for psychological traits. By at least some metrics, future scientific developments supported this early optimism: The Big Five became the dominant model within personality research (John et al., 2008), and various instruments developed to measure it quickly gained ascendancy over alternatives, such as those based on the earlier frameworks proposed by Hans Eysenck (Eysenck, 1964; Eysenck & Eysenck, 1975) and Raymond Cattell (Cattell et al., 1970). This primacy has been retained despite the introduction of competitors such as the HEXACO model (Lee & Ashton, 2004): In recent years (i.e., 2015 to 2017), the total citations given to the most prominent non-Big Five instruments is around 4,600¹, compared to around 11,500 among various Big Five

¹ Including those listed above as well as the Comrey Personality Scales (Comrey, 1970, 1980), the California Psychological Inventory (Gough, 1956), the Jackson Personality Inventory (Douglas N. Jackson, 1967; Douglas Northrop Jackson, 1974, 1979, 1994), the Minnesota Multiphasic Personality Inventory

measures², underscoring its dominance among broad assessments of personality.

Less recognized is the fact that, by other metrics, the Big Five has seemingly failed to live up to its billing as an organizing framework for personality. Despite the dominance of the Big Five for describing relatively broad features of personality, psychology continues to face an extraordinary degree of *construct proliferation*, as evidenced by the dizzying array of measures available for assessing (usually much narrower) trait-like individual differences (4,000 by one recent count: Rosenbusch et al., 2020). These measures of trait-like constructs (henceforth *stand-alone scales*, e.g., Aggression, Buss & Perry, 1992; Grit, Duckworth et al., 2007) are commonly viewed as being distinct from the Big Five, and are (collectively) used much more frequently. For example, one need only add the citation counts for two such measures (the Positive and Negative Affect Scales, PANAS, Watson et al., 1988 with 8,400 citations in the 2015 to 2017 period; and Rosenberg’s Self-Esteem Scale, Rosenberg, 1965, with 6,800 such citations) to handily surpass the citations given to *all* Big Five measures over the same period.

One interpretation of these citation trends is that the promise of the Big Five was only half-fulfilled. On the one hand, it has been widely accepted as capturing a useful set of broad, general, or “basic” personality characteristics. On the other hand, the extraordinary number of stand-alone scales that have been developed, and the frequency with which they are used in psychological research, may indicate that many of the most interesting trait-like characteristics are thought to lie beyond the boundaries of the Big Five. This suggests that the Big Five is not widely accepted by researchers as a

(James Neal Butcher, 1990; James N. Butcher et al., 1992; W. Grant Dahlstrom et al., 1972; W. G. Dahlstrom & Welsh, 1960; John R. Graham, 1987; John Robert Graham, 1990; Greene, 2000), the Multidimensional Personality Questionnaire (Patrick et al., 2002; A. Tellegen, 1982; Auke Tellegen & Waller, 2008), and the Temperament and Character Inventory (Cloninger et al., 1993; Cloninger, 1994). All citation counts here and below were sourced from Google Scholar (scholar.google.com).

² The popular Big Five questionnaires included in this total were the NEO-Personality Inventory-Revised (Costa & McCrae, 1985, 2008), the Big Five Inventory (John et al., 1991, 2008; John & Srivastava, 1999), the Ten-Item Personality Inventory (Gosling et al., 2003), the Big Five Aspect Scales (DeYoung et al., 2007), and the mini-IPIP (Donnellan et al., 2006).

comprehensive organizing framework for the universe of personality trait constructs. Interestingly, although the success or failure of the Big Five to fulfill this promise can be empirically evaluated, efforts to undertake such evaluations are surprisingly rare. The value of undertaking such an exercise is clear: An organizing framework for stand-alone trait scales would provide a shared nomenclature, making it easier for researchers to synthesize findings in the literature and communicate their own findings to the scientific community (John et al., 2008). Such communication would curtail the development of research “silos” organized around different sets of stand-alone scales and foster cumulative science (Baliotti et al., 2015; Le et al., 2010). Additionally, a shared nomenclature would help detect redundancy among stand-alone scales (i.e., the Jangle Fallacy, Kelley, 1927), which would facilitate a whittling down of the vast array of scales available into a more manageable list of those that are most useful with the best psychometric properties. Finally, as noted by Cattell in the opening quote (Cattell, 1987), an organizing framework facilitates the development of theories of psychological traits (e.g., Cybernetic Big Five Theory, DeYoung, 2015; the evolution of personality traits, Nettle, 2006). Integrating stand-alone scales within such a framework would foster further development of such theories as more findings could be readily compared to their predictions.

The Big Five is well past-due for an explicit evaluation of its potential to serve as an organizing framework for stand-alone psychological trait scales. Our aim in this paper is to provide the first comprehensive evaluation of this kind, within three new samples (N s = 253, 398, and 388) collected for this purpose.

The Big Five as an Organizing Framework for Psychological Traits

The Big Five was discovered through analyses of the covariance structure of participants’ ratings on representative sets of psychological trait terms. According to what is now known as the Lexical Hypothesis, a guiding assumption was that the most salient and consequential psychological differences between humans will, throughout history, have

been encoded in language (Ashton & Lee, 2005b; Galton, 1884; Goldberg, 1993). Thus, sets of lexical descriptors were created by compiling lists of *every* trait-descriptive word from dictionaries (e.g., Allport & Odbert, 1936) and then whittling down these lists (e.g., by eliminating synonyms) until a manageable selection remained (e.g., Cattell, 1943). Analyses of participants' ratings of themselves or others on these trait terms frequently yielded five factors that parsimoniously summarized participants' responses (Goldberg, 1993; John et al., 2008). These five dimensions (or domains) have become known as Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness to Experience (henceforth Openness). These analyses were repeated in different languages and cultural groups and found to be remarkably (though not completely) similar, suggesting they captured universal dimensions of human personality (De Raad, 1992; Hofstee et al., 1997; John et al., 2008).

Given that the Big Five was demonstrated to provide a comprehensive organizing framework for psychological traits as defined by trait *words*, it seems reasonable to assume that it would be similarly useful for organizing psychological traits as defined by trait *scales*. However, there have been relatively few attempts to confirm this empirically. Some researchers have attempted to demonstrate that specific scales can be well-described by the Big Five. However, such studies have tended to focus on scales that appear to represent instances of the Jangle Fallacy [i.e., where two differently named trait scales measure the same thing; Kelley (1927)] and may approach redundancy with one particular Big Five domain. For example, Pfattheicher et al. (2017) and later Geiger et al. (2018) argued that Self-Compassion (Neff, 2003) and its facets should, at least, be regarded as facets of Neuroticism. Although Neff et al. (2018) disputed some of the claims made by Pfattheicher et al. (2017), they nevertheless reported a correlation between Self-Compassion and Neuroticism of -0.76 (based on factor scores). For comparison, Soto and John (2017) found correlations of an average correlation of 0.77 (based on aggregate scores) between Big Five Inventory Neuroticism and Neuroticism as assessed in four other Big Five questionnaires

(excluding the BFI-2). These findings suggest that Self-Compassion (or its facets) can reasonably be considered as a facet of the Big Five nested under Neuroticism if not simply an alternative measure of Neuroticism. Similarly, Credé et al. (2016) and Schmidt et al. (2018) argued that Grit and its facets, especially the Perseverance facet, are either redundant with Conscientiousness and its facets or, at best, should be labeled as facets themselves (and the Grit authors have accepted this facet classification, Duckworth et al., 2019). Similar arguments have been made for Procrastination (Lay, 1986; Schouwenburg & Lay, 1995) and the Dark factor (Hodson et al., 2018; Vize et al., 2021).

Although these efforts are useful, scales that appear interchangeable with a single Big Five domain may only represent the tip of the iceberg—many more scales may be well described by the Big Five collectively without being reducible to any one domain. Such scales may share variance with *multiple* Big Five domains (i.e., as *interstitial* scales), or be non-redundant with but usefully described by the Big Five. Overall, studies motivated by potential instances of the Jangle Fallacy help to curb construct proliferation by scrutinizing one potentially redundant scale at a time, but tell us little about how well the Big Five would perform as an organizing framework for stand-alone psychological trait scales generally.

Other researchers have evaluated the effectiveness of the Big Five as an organizing framework for broad assessments of personality traits, without focusing on redundancy *per se*. For instance, B. P. O'Connor (2002) examined the share of variance explained by the Big Five for 29 broad assessments of personality, including, for example, the California Psychological Inventory (Gough, 1956), the Jackson Personality Inventory (Douglas Northrop Jackson, 1974), and various versions of the Minnesota Multiphasic Personality Inventory (W. Grant Dahlstrom et al., 1972). Although he found that only 39% of the variance of these assessments was described by the Big Five, he also noted that an average of just 50% of the variance within the inventories was described by their own factors. In that context, 39% was actually quite large. As a result, B. P. O'Connor (2002) concluded

that the Big Five could capture the variance of other broad inventories well.

In a similar vein, Markon et al. (2005) examined the factor structure of a broad collection of personality inventories and a single, comprehensive measure of abnormal personality [i.e., the Dimensional Assessment of Personality Pathology; Livesley et al. (1991)]. They found that a 5-factor solution—broadly matching the Big Five—was the most appropriate. Importantly, because only one of the personality inventories was a Big Five questionnaire, the structure was not overly influenced by the inclusion of Big Five scales within their analyses. Subsequent studies employing similar methods helped to confirm these conclusions (see Robert F. Krueger et al., 2011; R. F. Krueger et al., 2012; K. M. Thomas et al., 2013). Together, these studies suggest that the Big Five can provide a useful organizing framework for both normal and abnormal personality inventories.

Another relevant example focused on a large variety of assessments supposedly assessing the same construct—impulsivity (Whiteside & Lynam, 2001). Many impulsivity scales had been developed during the 1970s through 1990s (Evenden, 1999), often within different siloed research traditions, and the location of this construct within prominent trait models became a moving target—leading one commentator to label it “the lost dimension” (W. Revelle, 1997). In an effort to organize this region of trait space, Whiteside and Lynam (2001) assessed a variety of different impulsivity scales and demonstrated that they can be usefully organized within the space of the Big Five. Based on their findings, they proposed four dimensions of impulsivity: Premeditation and Perseverance (both reflecting low impulsivity) were aligned with Conscientiousness, whereas Urgency and Sensation Seeking (both reflecting high impulsivity) were aligned with Neuroticism and Extraversion, respectively. This study was a watershed in the impulsivity literature (according to Google Scholar, it has now been cited over 3,600 times), providing one of the first demonstrations that the various “impulsivity” scales actually measure substantially different constructs (see also Strickland & Johnson, 2021). Moreover, as for Markon et al. (2005), their results demonstrated how the Big Five can help to organize even complex

clusters of trait constructs.

Evaluating Claims of Scale Distinctness from the Big Five

Beyond the papers described in the previous section, few attempts have been made to evaluate the effectiveness of the Big Five as an organizing framework for stand-alone psychological trait scales. Scale development studies provide the occasional exception (e.g., Kashdan et al., 2004; McCullough & Hoyt, 2002; Petrides et al., 2007), although many such studies do not include assessments of the Big Five (Chen et al., 2001; e.g., Connor & Davidson, 2003; Diener et al., 2010; Neff, 2003; Smith et al., 2008; Vallerand et al., 2003). Furthermore, the usual apparent purpose of including a measure of the Big Five in a stand-alone scale development study is to demonstrate incremental validity of the new scale “above and beyond” the five domains (K. W. Brown & Ryan, 2003; e.g., Duckworth et al., 2007; Judge et al., 2003; Parker et al., 2011). Although incremental validity is necessary to demonstrate a scale’s utility, these demonstrations often have serious methodological or rhetorical problems. For instance, apparent incremental validity of one scale beyond that of another may be spurious if simple aggregate scores are used for the assessment (Westfall & Yarkoni, 2016). This is because most measures in psychology are far from perfectly reliable, and common statistical techniques do not take this unreliability into account when aggregate scores are used. Thus, any apparent incremental validity beyond the covariate of interest may be simply due to the scale capturing variance in the outcome caused by the covariate, but which was not captured by the covariate’s measure. Worryingly, in the event that there is no true incremental validity beyond the covariate, larger sample sizes inflate the false positive rate, as even tiny effects become statistically significant (Westfall & Yarkoni, 2016). This problem can be avoided by modeling the unreliability with Structural Equation Models (SEM), but most incremental validity studies to date were conducted prior to this problem becoming common knowledge, so such methods were not employed (K. W. Brown & Ryan, 2003; e.g., Duckworth et al., 2007;

Judge et al., 2003; Parker et al., 2011). Moreover, the problem is often compounded by the use of very short Big Five questionnaires, which attenuates relationships between the Big Five and other variables—among other problems (Credé et al., 2012). Overall, the majority of such studies serve to obscure, rather than illuminate, the potential utility of the Big Five as an organizing framework for personality traits.

Perhaps more importantly, the implications of even a statistically rigorous demonstration of incremental validity are limited. Consider the case of “facets.” Measures of broad traits—whether within multi-dimensional assessments such as those for the Big Five or a given stand-alone scale—often additionally assess empirically coherent sub-components of the broader trait space represented by a full scale. Such sub-components—“facets”—can often show incremental validity in the prediction of interesting outcomes. For example, five expert-chosen facets of the NEO PI-R have incremental validity beyond the broader Big Five domains when predicting academic performance (M. C. O’Connor & Paunonen, 2007; Paunonen & Ashton, 2001). Similarly, the Perseverance facet of Grit (Duckworth et al., 2007) has incremental validity beyond the Big Five when predicting academic performance, whereas the full Grit scale does not (Credé et al., 2016), suggesting the Perseverance facet would have incremental validity beyond the full scale.

Most such incremental validity demonstrations are unsurprising manifestations of the *bandwidth-fidelity* trade-off (Gleser et al., 1965); that is, the compromise between a measure that is optimal for the general case (i.e., a broad bandwidth scale) and a measure that is optimal for a specific case (i.e., a narrow, high-fidelity scale). Fidelity increases as the measure more closely approximates the actual behavior of interest, but at a cost to bandwidth. To the extent that the demonstrations of incremental validity for a given scale appear to be readily interpretable in terms of the bandwidth-fidelity trade-off—such as being primarily observed for a limited and somewhat narrow class of outcomes—then they would seem to provide little basis for seeing that scale as meaningfully independent. In the

context of evaluating the independence from the Big Five of a putative stand-alone construct, a demonstration that the construct has some circumscribed incremental validity beyond the Big Five is entirely consistent with the proposition that the construct represents a facet of the Big Five.

How do we decide if a scale can be located within the Big Five?

Given that incremental validity tests are not sufficient to assess whether a scale can be located in the Big Five, what better method can we use to address this question? One approach, similar to that used in the lexical tradition (described above), would be to factor analyze a collection of scales and evaluate the emerging structure. However, whereas the Lexical Hypothesis states that important psychological differences between humans are encoded in language, this may not be the case for stand-alone scales. Even a complete list of every scale developed may simply represent the prevailing research interests of scale developers, and provide little indication about the underlying structure of psychological traits. Given that the factors that emerge in factor analyses may be overly affected by the collection of scales chosen (Ashton & Lee, 2005b), factor analyses of stand-alone trait scales may not provide a compelling means to evaluate the Big Five's claim to provide an organizing framework for stand-alone scales.

Another approach would be to examine the amount of variance in a given scale that can be described by the Big Five. Saucier and Goldberg (1998) adopted this approach, focusing on a collection of trait terms that are not usually considered part of the Big Five. They demonstrated that the Big Five predicted empirically-derived clusters of these words reasonably well, with a multiple R of 0.3 or greater. They concluded from this that the Big Five was extraordinarily broad and encompassing, with few psychological traits being meaningfully distinct from it. The strength of this argument again depends on scale selection—were the included scales possibly biased in ways that favor or disfavor their argument? It also depends, and no less importantly, on the adequacy of the statistical

threshold—is a multiple R of 0.3 large enough to conclude that the word clusters are part of the Big Five? In a subsequent critique, Paunonen and Jackson (2000) noted that just 9% of a scale’s variance would have to be described by the Big Five to pass Saucier and Goldberg’s (1998) criterion, which they argued was too trivial to support the claim that a scale is part of the Big Five. They also pointed out that, by applying such a liberal criterion to relations among the Big Five domains themselves, it would appear that “even some of the Big Five factors do not fall beyond the space of the other four factors!” (Paunonen & Jackson, 2000, p. 831) Paunonen and Jackson (2000) thus argued that Saucier and Goldberg’s (1998) criterion was far too inclusive, and reanalyzed their data using a stricter criterion (an R^2 of 0.2, corresponding to a multiple R of 0.45). Unsurprisingly, they found that far fewer word-clusters appeared to fit within the Big Five, leading them to conclude: “What is Beyond the Big Five? Plenty!” (p. 821).

Of course, Paunonen and Jackson’s (2000) argument is vulnerable to the same concerns as Saucier and Goldberg’s (1998), and the arbitrary nature of the criteria proposed by both groups left the issue without a satisfying resolution. Indeed, this debate is perhaps most useful for demonstrating the difficulty of determining a satisfactory criterion for assessing whether or not a stand-alone scale can be located within the Big Five. However, we propose a solution to the impasse: A relatively restrictive and less arbitrary means to determine such a criterion is to examine the amount of variance in a given scale that can be described by the Big Five, relative to the share of variance of Big Five *facets* described by the Big Five.

This method has two key benefits: First, Big Five facets, explicitly constructed and validated as sub-scales of the Big Five domains, are conceptually and empirically part of the Big Five. This holds even though facets are—like most stand-alone scales—narrower in focus than the Big Five factors to which they belong, and thus often bring incremental predictive validity beyond the Big Five (e.g., Anglim et al., 2020; Danner et al., 2020). To the degree that a given stand-alone scale shows similar or even greater links with the Big

Five than is observed for some Big Five facets, it would be reasonable to conclude that the stand-alone scale can be located within the Big Five, perhaps as a facet itself.

Second, by generating criteria empirically using the same sample and method as used to classify the stand-alone scales, any bias that affects the estimates for the facets is likely to also affect the estimates for the stand-alone scales. This very substantially reduces a host of concerns, such as generalizability. For example, if a given sample is plagued by inattentive responding or imperfect language comprehension, this seems likely to reduce the association of Big Five domains not only with the stand-alone scales but also, to a broadly comparable extent, with the Big Five facets. Because of this, the conclusions of such analyses—that is, our assessment of the degree to which the Big Five domains show comparable relationships with stand-alone scales as with Big Five facets—should be robust to different samples or methods.

Nevertheless, some caution is needed when choosing specific methodological approaches. For example, if Big Five facets were typically less reliably measured than stand-alone scales, then their overlap with the Big Five might be artificially attenuated to a greater degree than the scales. This could, in effect, “lower the bar” when evaluating whether a stand-alone scale overlaps with the Big Five enough to be considered comparable to a Big Five facet. Thus, some method to correct for attenuation due to scale unreliability is required. Using the classical test theory method to correct for attenuation (Spearman, 1904) is only appropriate under specific circumstances that are rarely the case in practice (Borsboom & Mellenbergh, 2002; Zimmerman & Williams, 1980). However, using latent variable methods derived from modern test theory also correct for attenuation due to unreliability, and much more precisely than the traditional method (Borsboom & Mellenbergh, 2002; Westfall & Yarkoni, 2016). Thus, such models can be used to determine how much variance of both facets and stand-alone scales can be described by the Big Five, thereby allowing us to determine which scales can be reasonably located within the Big Five.

Where does a scale fall within the space of the Big Five?

The benefit of an organizing framework does not arise simply by virtue of knowing *that* some case can be captured by the framework, but also by specifying *where* within the framework the particular case falls. For instance, in our earlier example of impulsivity (Whiteside & Lynam, 2001), it was the *location* of each of the impulsivity facets under different Big Five domains that helped to describe and differentiate them, more so than the fact that they could be located within the Big Five. Therefore, in addition to determining whether particular stand-alone scales can be located within the Big Five, we also require a means to demonstrate these scales' locations.

In a typical Exploratory Factor Analysis (EFA), the location of each indicator within the structure is given by a weight or loading on each factor. These loadings indicate the relationship between the indicator and the factors. Relatively pure (or simple) indicators are characterized by a high loading on a single factor, whereas more complex or interstitial indicators have moderate to high loadings on multiple factors. As noted earlier, traditional factor analysis does not provide a compelling means to evaluate the Big Five as an organizing framework for psychological scales because the factors that emerge may be overly affected by the choice of scales (Ashton & Lee, 2005b). Conveniently, however, the models we suggest can be used to determine the share of variance of a stand-alone scale described by the Big Five also provide parameters for the relationship between each Big Five domain and the scale. These parameters can be assembled into a matrix and interpreted in the same way as loadings in traditional factor analyses, with the benefit that the factor rotations have not been influenced by the stand-alone scales of interest.

Summary

The promise of the Big Five as a comprehensive organizing framework is challenged, at least implicitly, by the extraordinary degree of construct proliferation within psychology.

It is more explicitly challenged when scale developers driving this proliferation argue that their new scales are sufficiently distinct from the Big Five such that their relationship with the Big Five can be ignored altogether. The lack of a *recognized* integrative framework for psychological scales makes it harder for researchers to synthesize across findings in the literature, allows for the development of research “silos” based around putatively distinct stand-alone scales, and threatens integrative and cumulative science (Baliotti et al., 2015; Le et al., 2010). Surprisingly, the adequacy of the Big Five as an organizing framework for stand-alone scales has received minimal investigation; this question is long overdue for thorough evaluation.

The current research

In this research project we sought to answer two questions: First, how effective is the Big Five as an organizing framework for stand-alone trait scales (RQ1)? Second, where are the stand-alone scales (included in this research) located within the Big Five (RQ2)? To answer RQ1, we compared the share of variance explained by the Big Five domains for each stand-alone scale to that of Big Five facets from an alternative questionnaire. To answer RQ2, we examined relations between each of the Big Five domains and each scale.

Our project included three samples across two studies. Study 1 was undertaken to determine “proof-of-concept,” where scales were selected based on our judgment that they were conceptually related to the Big Five and would be spread relatively evenly across the five domains. Because we selected scales that were expected to have at least a moderate connection to one or more Big Five domain, this method may over-estimate the share of variance of the stand-alone scales described by the Big Five compared to the population of such scales. Thus, in Study 2, we selected scales based on the number of times each scale was cited between 2015 and 2017 (i.e., the three years prior to the commencement of this project). For Study 1, although we predicted where particular constructs would be located within the Big Five for the purpose of having an even spread across the domains, our focus

was on how well the Big Five would be able to describe these scales rather than where they were located.

Study 1

Method

Ethical approval was granted by the Psychological Sciences Human Ethics Advisory Group at the University of Melbourne (Ethics ID: 1749928.1).

Participants. Participants were undergraduate students at a large Australian university who participated for course credit. From an initial sample of 306, participants were excluded after data collection if they failed to complete at least 25% of any scale or Big Five facet or 5% of all items, or if they failed more than one attention check. For legal reasons, participants were also excluded if they reported that they were under 18 years old. This resulted in a final sample of 253 participants aged 18 to 49 ($M=20.1$; $SD=3.2$; 71.1% female). The minimum sample size of 200 was targeted based on pre-registered analysis not performed here (see below), but the final sample size was sufficiently large for many effect sizes to stabilize to within 0.1 of their population values, given the reliability coefficients of the scales and effect sizes involved (Kretzschmar & Gignac, 2019). Most participants identified as either Caucasian (51.4%) or Chinese (24.5%) and all students from non-English-speaking countries had passed an acceptable level of the International English Language Test (www.ielts.org), such that their written English comprehension was sufficient for the difficulty of the items presented. Details of numbers excluded for each criterion and further demographic information of the final sample is reported in Supplement A (osf.io/f9hmg).

Materials

Big Five Questionnaires. The Big Five Inventory-2 (BFI-2, Soto & John, 2017) was included to measure the Big Five domains and a 120-item analogue of the NEO-PI-R (NEO, Costa & McCrae, 2008) drawn from the International Personality Item Pool [IPIP; Maples et al. (2014)] was included to measure the Big Five facets. Like the NEO, the IPIP assesses six facets for each domain. A NEO-based inventory was chosen as they assess a broad collection of facets, so were likely to provide a more reasonable collection for comparing stand-alone scales and Big Five facets. Separate inventories were used for the factor and facet estimation so that the facets could be included in models with the factors easily. All items were assessed on a five-point Likert scale with points labeled, “Strongly Disagree,” “Disagree,” “Neither agree nor disagree,” “Agree,” and “Strongly agree.”³

Stand-alone Scales. A list of scales was generated based on the authors’ knowledge and by searching Google Scholar (scholar.google.com) for trait terms thought likely to have a corresponding stand-alone scale. From this list, we selected scales to be approximately evenly distributed between the Five domains. Short forms of scales were preferred to maximize the number of included scales. As noted earlier, we conceptualized this strategy for selecting stand-alone scales as a means to establish “proof-of-concept”: If even scales that we suspected to overlap at least moderately with the Big Five did not, this would discourage further efforts to obtain a wider, more representative collection of stand-alone scales.

The survey comprised 42 scales, drawn from 21 questionnaires. Of these 42 scales, 17 assessed lower-order facets of broader traits (e.g., the Verbal Aggression facet of Aggression, Bryant & Smith, 2001). The full list of included scales was pre-registered

³ An item from the Liberalism facet of IPIP Openness—“Tend to vote for liberal political candidates”—was omitted because it may be misinterpreted in Australian samples given that the main conservative party is called the Liberal Party. Additionally, survey coding errors resulted in one item from the adventurousness facet of Openness to Experience and one item from the activity level facet of Extraversion in the IPIP being incorrectly replaced with a different item. Thus, the liberalism, adventurousness, and activity level facets of the NEO were assessed with 3 items instead of 4.

(aspredicted.org/pb4yz.pdf) and is reproduced in Table 1. A well-being related scale was excluded after data collection as we had mistakenly used an unofficial version of a proprietary scale.

Responses to the stand-alone scales were given using the same five-point Likert scale as the Big Five questionnaires. In some cases, this meant the response options were different to those suggested by the scale authors, but the agree-disagree format was always appropriate in such cases.

Procedure. The survey was coded in Qualtrics (www.qualtrics.com) and completed online. Items were organized within “blocks” of 15-16 items, with no block containing more than one item from any one scale. Block order was randomized for each participant and item presentation order within blocks was randomized for each participant; thus items from different scales were intermingled, maximizing item validity (Clifton, 2019). A pdf of the survey is available on the Open Science Framework (OSF; osf.io/f9hmg).

Data Analysis. Models were specified for each individual construct assessed. The general form of the models is shown in Figure 1, which depicts a regression of the stand-alone scale on the Big Five with latent variables to measure the various constructs involved. Exploratory Structural Equation Modeling (ESEM) latent variables were used to estimate the Big Five (Asparouhov & Muthén, 2009). ESEM was chosen because CFA models typically provide poor fit for Big Five inventories (Booth & Hughes, 2014; McCrae et al., 1996). However, the facet structure of the BFI-2 was not modeled to enable easy interpretation of scale locations (see RQ2). Factors were rotated obliquely with a targeted rotation aiming to keep cross-loadings at 0. All models were estimated using Maximum Likelihood.

Table 1

List of included scales and the samples in which they were assessed

Construct	Scale	Citation	Samples
Aggression	Buss-Perry Aggression Questionnaire	Bryant and Smith (2001)	1, 2a, 2b
Ambiguity Tolerance	Multiple Stimulus Types Ambiguity Tolerance Scale-II	McLain (2009)	1
BAS	Behavioral Activation System Scale	Carver and White (1994)	2a, 2b
BIS	Behavioral Inhibition System Scale	Carver and White (1994)	2a, 2b
Curiosity	Curiosity and Exploration Inventory-II	Kashdan et al. (2004)	1
Desirability of Control	Desirability of Control Scale	Burger and Cooper (1979)	1
Dogmatism	DOG Scale	Altemeyer (2002)	1
Emotion Regulation: Reappraisal	Emotion Regulation Questionnaire	Gross and John (2003)	2a, 2b
Emotion Regulation: Suppression	Emotion Regulation Questionnaire	Gross and John (2003)	2a, 2b
Empathy	Toronto Empathy Questionnaire	Spreng et al. (2009)	1
Empathy: Empathic Concern	Interpersonal Reactivity Index-Brief (B-IRI)	Ingoglia et al. (2016)	2a, 2b
Empathy: Fantasy	Interpersonal Reactivity Index-Brief (B-IRI)	Ingoglia et al. (2016)	2a, 2b
Empathy: Personal Distress	Interpersonal Reactivity Index-Brief (B-IRI)	Ingoglia et al. (2016)	2a, 2b
Empathy: Perspective-Taking	Interpersonal Reactivity Index-Brief (B-IRI)	Ingoglia et al. (2016)	2a, 2b
Flourishing	Flourishing Scale	Diener et al. (2010)	1
Gratitude	Gratitude Questionnaire- 6 (GQ-6)	McCullough et al. (2002)	1
Grit	Grit Scale	Duckworth et al. (2007)	1, 2a, 2b
Hope	Hope Scale	Snyder et al. (1991)	1, 2a, 2b
Impulsivity	Barratt Impulsiveness Scale-Short Form (BIS-15)	Spinella (2007)	2a, 2b
Intolerance of Uncertainty	Intolerance of Uncertainty Scale-Short Form (IUS-12)	Carleton et al. (2007)	1
Loneliness	De Jong Gierveld Loneliness Scales	de Jong-Gierveld and Kamphuis (1985)	1
Machiavellianism	Short Dark Triad (SD3)	Jones and Paulhus (2014)	1
Mindfulness	Mindful Attention Awareness Scale	Brown and Ryan (2003)	2a, 2b
Narcissism	Short Dark Triad (SD3)	Jones and Paulhus (2014)	1
Need for Cognition	18-Item Need for Cognition Scale	Cacioppo et al. (1984)	2a, 2b
Need for Structure	Personal Need for Structure Scale	Neuberg and Newsom (1993)	1
Optimism	Life Orientation Test (Revised)	Scheier and Carver (1985a); Scheier et al. (1994)*	1, 2a, 2b
Pain Catastrophizing	Pain Catastrophizing Scale	Sullivan et al. (1995)	2a, 2b
Presence of Meaning	Meaning in Life Questionnaire	Steger et al. (2006)	2b
Private Self-Consciousness	Self-Consciousness Scale	Scheier and Carver (1985b)	1
Psychopathy	Short Dark Triad (SD3)	Jones and Paulhus (2014)	1
Public Self-Consciousness	Self-Consciousness Scale	Scheier and Carver (1985b)	1
PWB	Psychological Well-Being Scales	Ryff and Keyes (1995)	2a, 2b
Satisfaction with Life	Satisfaction with Life Scale	Diener et al. (1985)	1, 2a, 2b
Search for Meaning	Meaning in Life Questionnaire	Steger et al. (2006)	2b
Self-Compassion	Self-Compassion Scale	Raes et al. (2011)	2a, 2b
Self-Control	Self-Control Scale	Tangney et al. (2004)	1, 2a, 2b
Self-Efficacy	New General Self-Efficacy Scale	Chen et al. (2001)	1
Self-Esteem	Self-Esteem Scale	Rosenberg (1965)	1, 2a, 2b
Self-Mastery	Mastery Scale	Pearlin and Schooler (1978)	2a, 2b
Social Anxiety	Self-Consciousness Scale	Scheier and Carver (1985b)	1
Social Support	Multidimensional Scale of Perceived Social Support	Zimet et al. (1988)	2a, 2b
Vitality	Vitality Scale	Ryan and Frederick (1997)	1
Worry	Penn State Worry Questionnaire	Meyer et al. (1990)	2a, 2b

Note:

Sample 1 used the Life Orientation Test to assess optimism, whereas Samples 2a and 2b used the Revised Life Orientation Test.

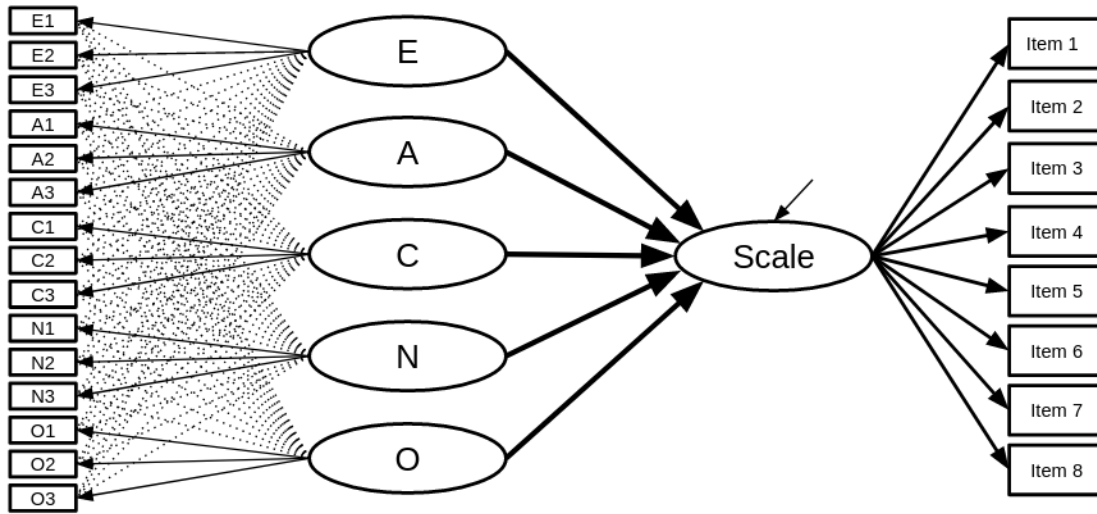


Figure 1. The General Form of the Exploratory Structural Equation Models.

Note: Up to 24 items were used as primary indicators of each Big Five domain, but only 3 are depicted to aid readability. All items had residual variance that is omitted from the figure.

The factor structure suggested by the original authors was used to make the assessment of how to model each scale's constructs.⁴ For scales presented as uni-dimensional (e.g., Need for Cognition, Cacioppo et al., 1984), the model was specified exactly as described in Figure 1. Similarly, for multi-scale inventories that assessed more than one (distinct) construct, a model was specified separately for each scale. Conversely, for scales presented as facets of an overarching domain, a separate model was specified for each facet scale, with an additional model specified for the full composite scale. For example, the Short Dark Triad (Jones & Paulhus, 2014) measures the three largely independent Dark Triad constructs, and thus was analyzed in three separate models. Conversely, the Buss-Perry Aggression Questionnaire (Bryant & Smith, 2001; Buss & Perry, 1992) measures four facets of a higher-order aggression factor, so was thus analyzed in four separate models for each facet plus a fifth model for the full scale.

⁴ The facet structure of Desirability of Control (Burger & Cooper, 1979) presented in the original paper was ambiguous (the authors performed two EFAs and half the items loaded on different factors from sample to sample), so we used the 3-factor structure identified by A. Thomas et al. (2011), which omitted 5 of the 20 items. Accordingly, only 15 of the 20 items for which responses were collected were used in the analysis.

The full scale models for multifaceted inventories used bi-factor measurement models to estimate the relevant scales' latent variables. The general form of these models is shown in Figure 2. This figure depicts a scale measured with a general factor (i.e., the main construct assessed by the inventory; e.g., aggression) and two group factors (i.e., the facets of the inventory; e.g., hostility), which capture the variance shared by all items and items specific to the facets, respectively. Group factors and the general factor were forced to be orthogonal. The scale's general and group factors were correlated with the Big Five factors, and these correlations were used to regress each scale's general factor on the Big Five factors.⁵⁶

The models were estimated using the BFI-2 to measure the Big Five factors. From these models, R^2 values, indicating the share of variance of each stand-alone scale described by the Big Five, were used to assess how well the Big Five could describe the collection of scales. The distribution of R^2 values was used to assess the effectiveness of the Big Five as an organizing framework for the collection of scales (RQ1). The regression coefficients indicating each factor's relationship with each scale were used as indicators of each scales' location within the Big Five (RQ2).

These models were also estimated with the facets of the IPIP in place of the stand-alone scales. These models indicated the overlap that typical facets of the Big Five assessed using one inventory have with measures of the Big Five domains assessed using another inventory. Given that facets are locatable within the Big Five, if a stand-alone scale has a similar overlap as at least a few of the Big Five facets, it might reasonably be considered locatable within the Big Five itself. These models were used to establish criteria for assessing the degree of overlap between the Big Five and the stand-alone scales. The

⁵ Using correlations rather than regression in the model was required so that the scales' general and group factors could be forced to correlate at 0.

⁶ To test the robustness of the bi-factor models, alternative models were employed, but produced similar results, suggesting that the bi-factor models were not inappropriate. A description of the alternative models and a comparison between these models' results are reported in Supplement C (osf.io/f9hmg).

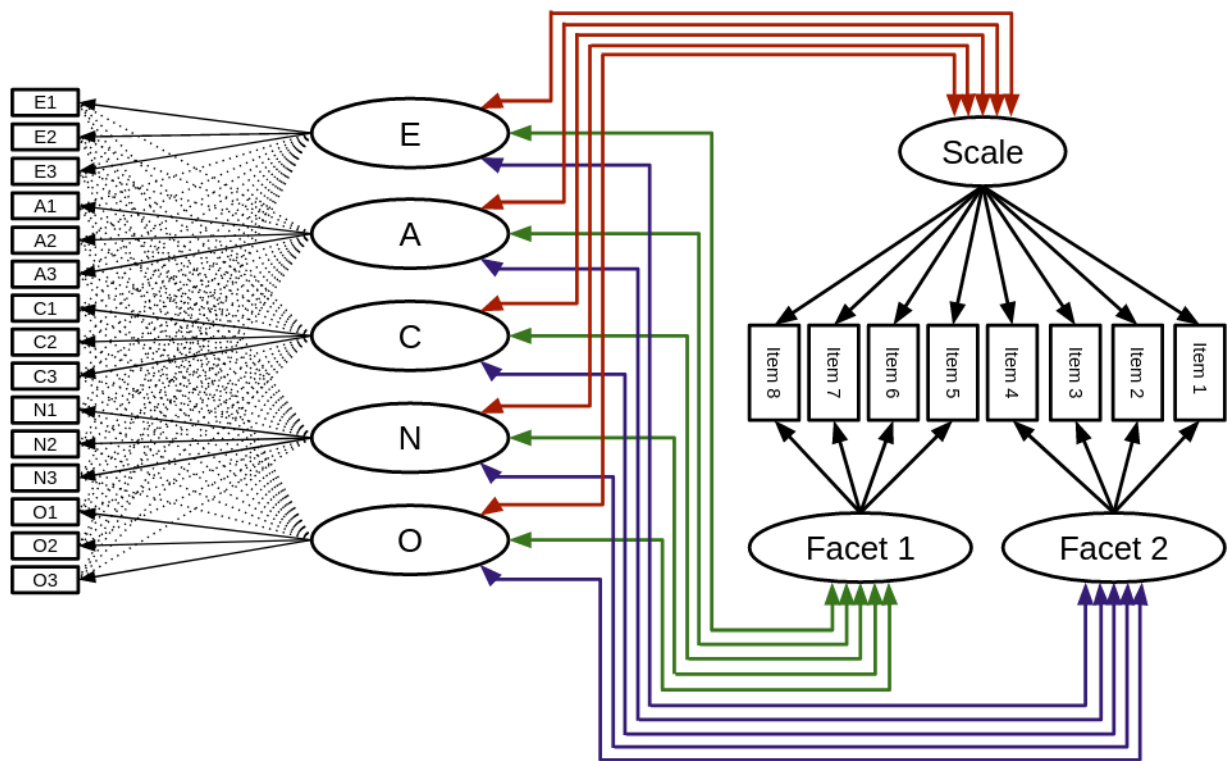


Figure 2. The General Form of the ESEMs with Bi-Factor Measurement Models.

Note: Up to 24 items were used as primary indicators of each Big Five domain, but only 3 are depicted to aid readability. All items had residual variance that is omitted from the figure.

criteria specified were the 10th, 20th, and 27th largest IPIP facet R^2 values, which allowed us to distinguish four different classifications: any scale with an R^2 greater than or equal to the 10th largest IPIP facets' R^2 would be classed as “Highly Reflective of the Big Five” (hereafter Highly Reflective); any scales with R^2 greater than or equal to the 20th IPIP facet's R^2 (but less than the 10th facet) would be classified as “Reflective of the Big Five to an Average Degree” (Average); any scale with R^2 greater than or equal to the 27th IPIP facet's R^2 (but less than the 20th facet) would be classified as “Somewhat Independent from the Big Five” (Somewhat Independent); and any stand-alone scale whose R^2 value was less than that of the 27th largest facet's R^2 would be classed as “Peripheral or Largely Independent from the Big Five” (Peripheral; even though this would also apply to three Big

Five facets).⁷ We also examined results using the 30th IPIP facet, as well as the criteria used by Paunonen and Jackson (2000) and Saucier and Goldberg (1998), reviewed in the introduction. The four classifications based on IPIP facet R^2 values were subsequently pre-registered for both Study 2 samples, however none of the additional criteria (i.e., 30th facet and values from the previous literature) were pre-registered for any sample.

The proportion of scales surpassing each of these criteria and their accompanying confidence intervals were computed. These proportions were used to assess the relative success of the Big Five as an organizing framework for the scales assessed. Wilson’s method was used to calculate confidence intervals (Wilson, 1927; see also Agresti & Coull, 1998; L. D. Brown et al., 2001).

Estimation Procedures. To estimate each model a 2-stage estimation procedure was used (Burt, 1976). This procedure involves first estimating the measurement model parameters and then fixing these values in the full model. This 2-stage procedure prevents interpretational confounding (Burt, 1976), a problem when structural parameters are estimated in the same stage as measurement parameters. In some cases, this results in latent factors being substantially defined by theoretically separate external factors.⁸ The 2-stage procedure was applied only to the stand-alone scales and not to the Big Five because the Big Five had many more items and was thus far less prone to interpretational confounding. For comparison, simultaneously estimated models were also examined. In some cases, the bias from failing to adopt the 2-stage procedure would have been extreme. See Supplement C for further consideration of this issue and for results from the

⁷ We adopted this later, arguably quite conservative criterion, after noticing that a couple of the IPIP facets did not have satisfactory levels of reliability, which we did not want to influence the final criterion.

⁸ This problem arises when items are forced to be independent of external latent variables in the model when this assumption is incorrect. Variance related to the external factor is then “pushed” into the latent variable, altering the interpretation of the latent variable to be partly defined by the external factor. In our case, this would mean that the parameters defining the stand-alone scales’ latent variables may have been partly determined by the Big Five rather than being purely determined by the stand-alone scale’s items, which would have inflated the apparent overlap between the Big Five and the stand-alone scales in some cases (see Supplement C; osf.io/f9hmg).

simultaneously estimated models (osf.io/f9hmg).

Statistical Software and Packages. All analyses were conducted using R (R Core Team, 2021) within the RStudio environment (RStudio Team, 2015) with the exception of the ESEM (Asparouhov & Muthén, 2009), which was conducted with Mplus version 8.2 [Linux version; Muthén and Muthén (1998)] via R with the aid of the MplusAutomation package (Hallquist & Wiley, 2020). Additional packages are reported in the Appendix. All R code and data, and Mplus input, output, and data files are available on the Open Science Framework (OSF; osf.io/f9hmg).

Pre-Registration. Although we pre-registered some analyses (aspredicted.org/pb4yz.pdf), our analysis plan was incrementally adjusted between this Study and the samples in Study 2 as we identified improvements to our analysis strategy. We believe the most recent pre-registration (i.e., that of Sample 2b; see Study 2 for details; aspredicted.org/az42w.pdf) specifies the most defensible methods for answering our research questions, so the analyses presented here are the same as those pre-registered for the later study. Thus, the analyses presented here were not pre-registered for this study.

We also pre-registered that we would exclude any participant who failed any attention checks, but instead decided to follow the less stringent exclusion criteria pre-registered for Study 2. These specified that participants could fail one attention check rather than none. Using the strict original exclusion condition would have resulted in about a third of the sample being excluded, which may have had a deleterious effect on the representativeness of the sample or made comparisons between samples more difficult. We judged it acceptable to deviate from this aspect of the Study 1 pre-registration because all the analyses we performed with this sample were exploratory. Nevertheless, as demonstrated in Supplement B (osf.io/f9hmg), repeating the analyses with the original pre-registered exclusion criterion made very little difference to the results of the study.

Results

Reliability. Reliability was estimated with omega coefficients (McDonald, 1978, 1999). BFI-2 facets, IPIP facets', and scales' omega reliabilities from the CFAs are reported in Supplement A (osf.io/f9hmg). Reliabilities for some scales were less than adequate, but, because latent variables correct for unreliability (Borsboom & Mellenbergh, 2002), likely did not have a substantial effect on R^2 estimates. However, given the comparatively small number of scales, we could not rule out a meaningful association—the correlation between R^2 and omega was 0.20, 95% CI [-0.15, 0.50], $p = .246$.

Fit Statistics. All fit statistics (i.e., those of the CFA, bi-factor, and EFA measurement models, and those of the ESEM) are reported in Supplement D (osf.io/f9hmg). Many of the CFA and bi-factor models' fit statistics were not ideal, but most were acceptable. As a result, the broad patterns of results should not have been overly affected by poorly fitting measurement models for the various scales and their facets.

The RMSEA of the BFI-2 EFA measurement model was 0.063, 90% CI [0.059, 0.066], indicating fair (MacCallum et al., 1996) or close to acceptable (Hu & Bentler, 1999) fit. As the fit of the structural models were largely determined by the EFA measurement model, their fit was similar to that of the EFA measurement model in all cases.⁹

Measurement Model Parameters. EFA, CFA, and bi-factor measurement model parameter estimates are reported in Supplement E (osf.io/f9hmg). In a five factor EFA with targeted rotation, all bar one BFI-2 item loaded primarily on the correct domain

⁹ The less-than-ideal fit of the EFA measurement model was likely due to our choice not to model the facet structure of the BFI-2. However, as noted in the method section, this choice enabled easy interpretation of scale locations (for RQ2). Moreover, as noted in the introduction, these models were sufficient to offset most of any effect of unreliability in the Big Five facets—a primary benefit of latent variable models over aggregate scores—and were used to generate the criteria and assess the scales, so less than optimal measurement would have affected both the scales' R^2 values and the criteria used to assess scales' R^2 values. Finally, a key problem of misspecified models—interpretational confounding (Bainter & Bollen, 2014; Burt, 1976)—was not an issue for the EFA measurement model (as indicated by only very small changes in parameter estimates between the EFA measurement model and the full ESEM structural models) and was accounted for with the 2-stage procedure for the scales' measurement models.

and there were just two cross-loadings with a magnitude greater than 0.3, indicating an acceptable EFA model.

Average R^2 and Category Criteria. The average R^2 of the stand-alone scales predicted by the BFI-2 factors was 0.53, compared to 0.62 for the IPIP facets. The R^2 values of the IPIP facets were used to generate criteria for interpreting the R^2 values of the stand-alone scales. In particular, the 27th facet of 30, as sorted by R^2 , was used to distinguish scales that were “peripheral or largely independent from the Big Five” from those that were sufficiently closely related to the Big Five to be located within the Big Five. This facet had an R^2 of 0.37. These criteria and the R^2 values of the stand-alone scales and IPIP facets are reported in Supplement A (osf.io/f9hmg).

The Proportion of Stand-Alone Scales to Pass Each Criterion. The Big Five factors described at least as much variance in 83.3%, 95% CI [69.4%, 91.7%], of the 42 stand-alone scales and their facets as they did for the 27th IPIP facet. This proportion dropped to 59.5% [44.5%, 73.0%] when compared to the 20th facet, indicating that a small majority of the stand-alone scales were “Reflective of the Big Five to an Average Degree.” Whereas only one scale surpassed the R^2 of the 10th facet (i.e., 2.4%, [0.4%, 12.3%]), all but one scale surpassed the R^2 of the 30th facet (i.e., 97.6%, [87.7%, 99.6%]). As this latter criterion was very close to that of Paunonen and Jackson [0.2; (2000)], exactly the same proportion of scales surpassed their criterion as the 30th facet (i.e., all but one). However, had we employed Saucier and Goldberg’s criterion [0.09; (1998)], 100% [95.4%, 100%] of the stand-alone scales would have been locatable within the Big Five. Overall, these results suggest that relations between our sample of stand-alone scales and Big Five is broadly comparable to that of the Big Five facets, supporting the potential for the Big Five to serve as an organizing framework for stand-alone psychological trait scales.

Where are the Stand-Alone Scales Located Within the Big Five? Scale locations in the Big Five were readily interpretable. However, because our scale selection method for Study 1 involved attempting to select scales relatively evenly spread between

the five domains, the patterns may reveal more about our selections than about patterns in the full corpus of stand-alone scales. As a result, regression coefficients are reported in Supplement A (osf.io/f9hmg) and discussion of scale locations is reserved for Study 2 (see below).

Summary

The results from Study 1 demonstrated that over 80% of stand-alone scales were as closely related to the Big Five as at least four of the Big Five facets, with 60% showing “average” degrees of connection to the Big Five (i.e., R^2 values greater than the 20th most Big Five-connected facet). For the most part, the locations of these scales within the Big Five were readily interpretable. These observations suggest that the Big Five would provide an adequate organizing framework for the scales selected for this study. However, our scale-selection method may have been biased toward scales that have some relation with the Big Five, and thus may not generalize to the corpus of scales in the research literature. Thus, although the results of Study 1 were promising—providing the hoped-for proof of concept—further research with a scale-selection method unlikely to be biased in favor of the Big Five was required.

Study 2

Satisfied with our proof-of-concept demonstration, our aim in our second study was to provide a conceptual replication of Study 1 using a collection of scales selected without a clear bias in favor of the Big Five. To achieve this aim, we selected the most extensively cited scales in the three calendar years prior to the commencement of Study 2 in 2018 (i.e., 2015 to 2017). Citations are quantifiable, readily available, and can be independently confirmed. By selecting only *highly cited* scales, our results were unbiased by our own preconceptions of the likely relationships between the Big Five and any particular scale. There also did not seem any reason to suspect that citation count would be associated with

the degree of shared variance between a scale and the Big Five. As an added bonus, by selecting scales according to citation counts, the study would prioritize those scales of most interest to researchers.

For Study 2, we collected two new samples (Sample 2a and Sample 2b). Where applicable (e.g., when synthesizing across samples), we also included data from Study 1 (i.e., wherever a highly cited scale was assessed in Study 1, hereafter also labeled Sample 1).

Method

Ethical approval was granted by the Psychological Sciences Human Ethics Advisory Group at the University of Melbourne (Ethics IDs: 1749928.2 and 1749928.3).

Participants. Participants in Sample 2a were undergraduate students at a large Australian university who participated for course credit. Participants in Sample 2b were MTurk workers (www.mturk.com) from the United States with approval ratings of at least 98%. The MTurk sample was collected in May 2019. From initial sample sizes of 493 (Sample 2a) and 406 (Sample 2b), participants were excluded for failing to complete at least a third of any scale or half of any Big Five facet; for failing more than one attention check; or for indicating that they did not respond honestly. In Sample 2a participants were also excluded if they completed less than 95% of all items or reported that they were under 18 years old. In Sample 2b, participants were asked whether we should include their responses in our study, but no participants indicated that we should not. The final sample sizes were 398 (Sample 2a) and 388 (Sample 2b). Minimum sample sizes of 250 (Sample 2a) and 300 (Sample 2b) were partly based on convenience and partly on the acceptability of standard errors of the same analyses performed in Study 1. These sample sizes were sufficient for most of our effect sizes to stabilize to within 0.1 of their population values given the reliability coefficients of the variables and effect sizes involved (Kretzschmar & Gignac, 2019).

Participants in Sample 2a were aged 18 to 40 ($M=19.9$, $SD=2.8$), whereas the age profile in Sample 2b was more representative of the adult population, aged 19 to 73 ($M=36.2$, $SD=10.5$). Most participants in Sample 2a identified as either Caucasian (39.7%) or Chinese (34.7%), whereas most in Sample 2b participants identified as Caucasian (82.5%). As for Study 1, all participants from non-English-speaking countries in Sample 2a had passed the International English Language Test to a sufficient level to understand the items presented. Further demographic information and the number of participants excluded for each exclusion criterion is reported in Supplement A (osf.io/f9hmg). Approximate sample sizes and the exclusion criteria were pre-registered for both samples.

Materials

Big Five Questionnaires. As for Study 1, the BFI-2 (Soto & John, 2017) was included to measure the Big Five factors and the IPIP (Maples et al., 2014) was included to measure the Big Five facets. All items were assessed on a five-point Likert scale with points labeled, “Strongly Disagree,” “Disagree,” “Neither agree nor disagree,” “Agree,” and “Strongly agree.” To improve upon the poor reliability observed for a few IPIP facets in Study 1, some were altered slightly for Study 2. These changes were pre-registered (aspredicted.org/ik33u.pdf, aspredicted.org/az42w.pdf). All of the IPIP items were also included in the survey to enable comparison between the original and altered scales, if desired.

Stand-alone Scales. Stand-alone scales were selected based on number of citations between 2015 and 2017 (i.e., the three years prior to the commencement of data collection for Sample 2a). The list of scales from which these were selected was an updated version of the list created for Study 1. Additional scales were sourced by searching within relevant research areas for all articles sorted by citations on Scopus (www.scopus.com) and from the *Handbook of Individual Differences in Social Behavior* (Leary & Hoyle, 2009) and *Measures of Personality and Social Psychological Constructs* (Boyle et al., 2015). The results of the Scopus searches and the final full list are available on the OSF (osf.io/f9hmg). Original

scales were replaced by short-forms if available. Scales were excluded based on the following criteria:

1. An alternative scale assessing the same construct had more citations (e.g., the Five Facet Mindfulness Questionnaire, Baer et al., 2006; which was cited fewer times than the Mindful Attention and Awareness Scale, K. W. Brown & Ryan, 2003);
2. The scale was designed to apply to specific groups or contexts rather than general populations (e.g., Job Burnout for employees, Maslach et al., 2001);
3. The scale was not easily administered on a 5-point Likert scale with ratings of agreement (e.g., the Subjective Happiness Scale, Lyubomirsky & Lepper, 1999);
4. The scale assessed beliefs about the world (including other people) rather than descriptions of oneself (e.g., Social Dominance Orientation, Pratto et al., 1994);
5. The scale measured a diffuse set of constructs or facets (specifically, five or more, e.g., values, Schwartz, 1992; and strengths, Peterson & Seligman, 2004);
6. The scale asked about one's state or frequency of symptoms during a specific time-frame (e.g., the last 4 weeks), rather than about one's general tendencies (e.g., Center for Epidemiologic Studies Depression Scale, CES-D, Radloff, 1977);
7. The scale was longer than 20 items and no short-form (with 20 or fewer items) was available;¹⁰
8. The scale format was inappropriate for our study design, as in the case of an interview or symptom checklist (e.g., Beck Depression Inventory-II, Beck et al., 1996);
9. The scale was an assessment of response quality (e.g., the Marlowe-Crowne Social Desirability Scale, Crowne & Marlowe, 1960); or
10. The scale was proprietary or restricted.

The final list of scales assessed was pre-registered (aspredicted.org/ik33u.pdf; aspredicted.org/az42w.pdf) and is presented in Table 1. Meaning in Life (Steger et al.,

¹⁰ Any scale that failed to pass this condition also failed at least one additional condition.

2006), which did not violate any of the conditions required for inclusion and had been cited a sufficient number of times to warrant selection, was not included in Sample 2a as we were unaware of the scale's existence when the sample was administered. It was added for Sample 2b. As for Study 1, a well-being related scale was excluded from Sample 2a after data collection as we had mistakenly used an unofficial version of a proprietary scale. Sample 2a comprised 50 scales, drawn from 19 questionnaires. Of these 50 scales, 26 assessed lower-order facets of broader traits. Sample 2b assessed the same scales again, plus the two Meaning in Life scales (Steger et al., 2006).

The same 5-point Likert scale was used to assess the scales as was used for the Big Five questionnaires. In some cases, this meant the response options were different to those suggested by the scale authors, but the agree-disagree format was always appropriate in such cases.

Procedure. The survey was constructed in the same way as for Study 1 with the exception that the number of items per block was reduced to 7 for scales and 8 or 9 for Big Five measures. Each block contained the same items in Samples 2a and 2b with the exception of the 10 meaning in life items added for Sample 2b. A pdf for each survey is available on the OSF (osf.io/f9hmg).

Data Analysis. The same models, estimation procedures, and criteria for classifying scales were used for Study 2 as were used for Study 1. However, the principle results reported are from meta-analyses across all samples within which each scale was assessed. Where a scale assessed in Study 2 was also assessed in Study 1, the data from Study 1 were also included in the meta-analysis.¹¹

R^2 values for stand-alone scales and IPIP facets were meta-analyzed to create single meta-analytic R^2 values. As for each sample, the meta-analytic R^2 of the 10th, 20th, 27th,

¹¹ The 8-item version of the Life Orientation Test [excluding filler questions; Scheier and Carver (1985a)] was used in Study 1, while the updated 6-item measure [excluding filler questions; Scheier et al. (1994)] was used in Study 2. These scales shared 5 items and were designed to assess the same construct so were meta-analyzed together.

and 30th IPIP facets (as sorted by meta-analytic R^2) were used to construct criteria with which to evaluate the stand-alone scales' R^2 . Because stand-alone scales were assessed in different samples (some only in the Study 2 samples, others in all three samples), two corresponding sets of criteria were created (i.e., one based on Study 2 samples, and another based on all three samples). Each scale was compared to the criteria corresponding to its sample inclusion.

Statistical Software and Packages. The meta-analyses were conducted in R with the meta package (Schwarzer, 2007). All other analyses were conducted in the manner described in Study 1, using the same statistical software and packages. As for Study 1, all R code and data, and Mplus input, output, and data files are available on the OSF (osf.io/f9hmg).

Pre-Registration. The criteria to classify scales were pre-registered for both Study 2 samples. The model described in Study 1 was pre-registered for Sample 2b (aspredicted.org/az42w.pdf) and a variant of this model was pre-registered for Sample 2a (aspredicted.org/ik33u.pdf), where factor scores were pre-registered in the place of the ESEM. However, we believe the method pre-registered for Sample 2b is the most defensible and that it would be confusing to employ a different method for each sample. Thus, only results from the analysis pre-registered for Sample 2b are reported here, but we report alternative, pre-registered analyses in Supplement B (osf.io/f9hmg). These results yielded similar conclusions to those based on the following results. The primary results reported are from the meta-analyses, which were not pre-registered.

Results

Reliability. As in Study 1, BFI-2 facets', IPIP facets', and stand-alone scales' omega reliability coefficients are reported in Supplement A (osf.io/f9hmg). The reliability of some stand-alone scales were less than adequate, but, most were sufficient for estimated correlations to stabilize (Kretzschmar & Gignac, 2019) and a small, non-significant,

meta-analytic correlation between R^2 and omega (across all 3 samples; $r = 0.11$, 95% CI [-0.07, 0.29], $p = .237$) suggested that any lack of reliability had little effect on the measured relationship between the Big Five and the stand-alone scales.

Fit Statistics. All fit statistics (i.e., those of the CFA, bi-factor, and EFA measurement models, and those of the ESEM) are reported in Supplement D (osf.io/f9hmg). Many of the CFA and bi-factor models' fit statistics were not ideal, but most were acceptable, so, as for Study 1, were unlikely to have had a major effect on the aggregate results.

The RMSEA values were 0.061, 90% CI [0.059, 0.064], for Sample 2a and 0.076, [0.074, 0.079], for Sample 2b. Although both values indicated fair fit according to one criterion (MacCallum et al., 1996), the fit for Sample 2b, in particular, was somewhat less than acceptable by more modern metrics (e.g., Hu & Bentler, 1999). As noted in the Study 1 method, the facet-structure of the BFI-2 was not modeled to enable easy interpretation of factor locations for RQ2. This was likely the primary cause of the less than ideal fit, but probably did not overly affected the R^2 of the models. As for Study 1, the fit of the ESEM were largely determined by the EFA measurement model, so their fit was similar to that of the EFA measurement model in all cases.

Measurement Model Parameters. EFA, CFA, and bi-factor measurement model parameter estimates are reported in Supplement E (osf.io/f9hmg). In Sample 2a, a five factor EFA with targeted rotation resulted in a solution where all items loaded primarily on the correct domain and there were just two cross-loadings exceeding 0.3. In an identical model, the solution was somewhat worse for Sample 2b. Four items loaded primarily on the wrong domain and there were multiple cross-loadings exceeding 0.3.

Average R^2 and Category Criteria. The meta-analytic average R^2 of the stand-alone scales predicted by the BFI-2 ESEM factors was 0.51, 95% CI [0.46, 0.56], compared to 0.64 [0.57, 0.70] for the IPIP facets. The R^2 values for the IPIP facets were

used to derive criteria for sorting the stand-alone scales into one of four categories (i.e., “Highly Reflective of the Big Five,” “Reflective of the Big Five to an Average Degree,” “Somewhat Independent from the Big Five,” and “Peripheral or Largely Independent from the Big Five”; see the method section of Study 1). We also report the R^2 for the facet with the lowest overlap with the BFI-2 factors. The meta-analytic R^2 values for each scale are reported in Figure 3. The sample-specific R^2 values of the stand-alone scales and IPIP facets, the various criteria, and an equivalent figure to Figure 3 for the IPIP facets are reported in Supplement A (osf.io/f9hmg).

It is worth underscoring the fact that the criterion we derived to suggest that a scale is “Peripheral or Largely Independent from the Big Five” (an R^2 of .40 in the meta-analysis of all three samples) is substantially more restrictive than those suggested by previous researchers, as described in the introduction. Specifically, it is over four times higher than the very inclusive criterion used by Saucier and Goldberg (1998) and is twice as high as the criterion suggested by Paunonen and Jackson (2000) in response. Had we instead decided to use the least related facet as the criterion (an R^2 of .28 in the meta-analysis), the resultant criterion would have still been more restrictive (in Samples 2a, 2b, and the meta-analytic results) than that used by Paunonen and Jackson (2000). This seems to support their claim that their chosen criterion, though much stricter than Saucier and Goldberg’s (1998) suggested R^2 of .09, was nevertheless quite inclusive (Paunonen & Jackson, 2000).

The Proportion of Stand-Alone Scales to Pass Each Criterion. The percentage of scales to pass each criterion, and associated confidence intervals, are reported in Table 2. The table reveals that 71.2% of scales were at least as related to the Big Five as the 27th facet (of 30, as sorted by R^2) and 40.4% of scales were at least as related as the 20th Big Five facet and thus “Reflective of the Big Five to an Average Degree.” No scales were as closely related to the Big Five as the 10th Big Five facet. As we found in Study 1, criteria used in previous studies classified substantially more stand-alone scales as closely

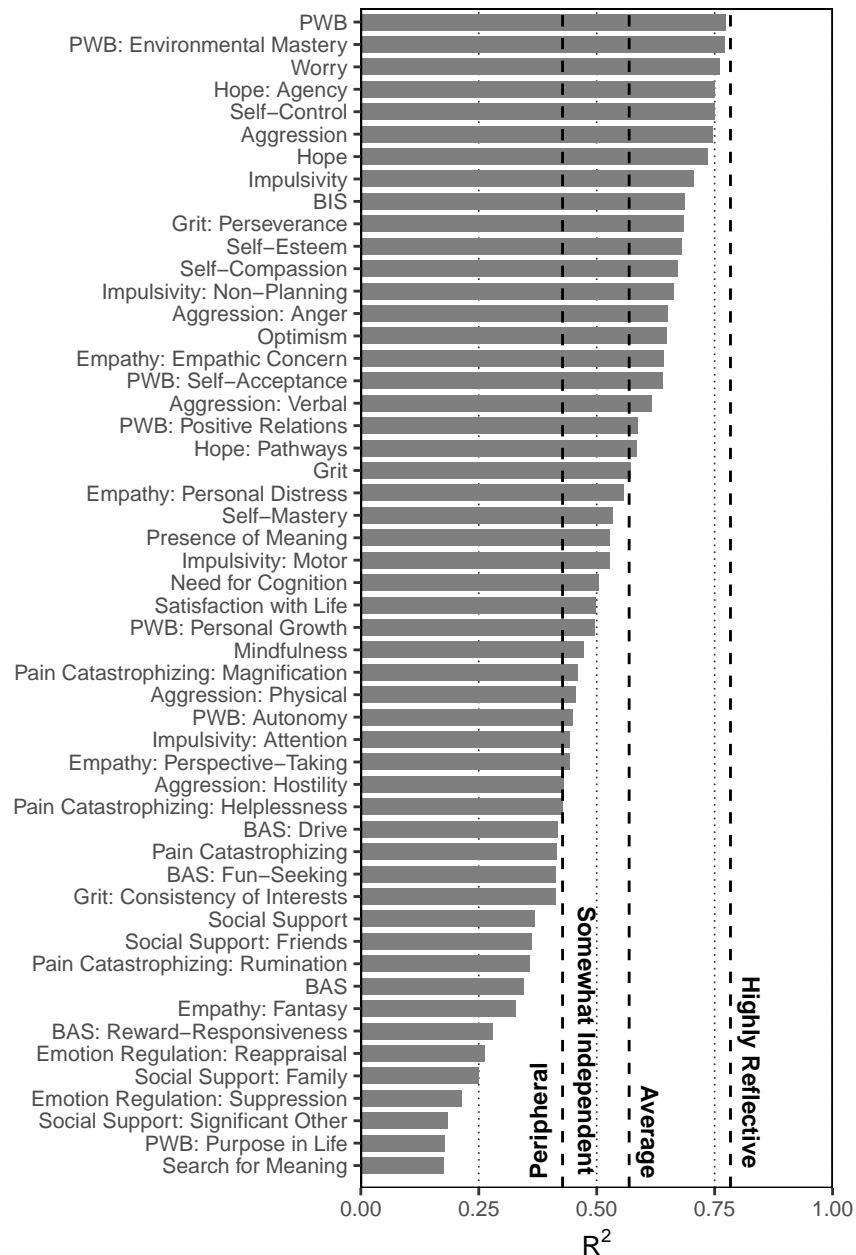


Figure 3. Meta-Analytic R^2 Values in Study 2.

Note: The dashed lines indicate the criteria to separate categories based on meta-analytic values computed from Samples 2a and 2b. Thus, they are not perfectly accurate for scales also included in Study 1. PWB = Psychological Well-Being; BAS = Behavioral Activation System Scale; BIS = Behavioral Inhibition System.

connected to the Big Five. Specifically, Saucier and Goldberg’s (1998) criterion would have suggested that all of the scales could be located within the Big Five, whereas Paunonen and Jackson’s (2000) criterion would have suggested that 94.2% could be. Overall, these results suggest that the Big Five can usefully serve as an organizing framework for stand-alone psychological trait scales.

Table 2

Cumulative Percentage of Highly Cited Scales to Pass Each Criterion

Category	Criteria	Sample 1	Sample 2a	Sample 2b	Meta-Analysis
Highly Reflective	10th facet (0.78)	0.0 [0.0, 20.4]	2.0 [0.4, 10.5]	9.6 [4.2, 20.6]	0.0 [0.0, 6.9]
Average	20th facet (0.57)	73.3 [48.0, 89.1]	46.0 [33.0, 59.6]	28.8 [18.3, 42.3]	40.4 [28.2, 53.9]
Somewhat Independent	27th facet (0.43)	86.7 [62.1, 96.3]	82.0 [69.2, 90.2]	63.5 [49.9, 75.2]	71.2 [57.7, 81.7]
The Least Related facet	30th facet (0.28)	100.0 [79.6, 100.0]	88.0 [76.2, 94.4]	92.3 [81.8, 97.0]	86.5 [74.7, 93.3]
Paunonen & Jackson (2000)	0.20	100.0 [79.6, 100.0]	92.0 [81.2, 96.8]	98.1 [89.9, 99.7]	94.2 [84.4, 98.0]
Saucier & Goldberg (1998)	0.09	100.0 [79.6, 100.0]	100.0 [92.9, 100.0]	100.0 [93.1, 100.0]	100.0 [93.1, 100.0]

Note: Sample 1 percentages are only for highly cited scales in the sample. Values in brackets represent 95% confidence interval bounds. Criteria in parentheses indicate the meta-analytic criteria generated from the IPIP facets in the Study 2 samples. The number of scales used for the calculations were: 15 (Sample 1), 50 (Sample 2a), and 52 (Sample 2b).

Where are the Stand-Alone Scales Located Within the Big Five? Figure 4 shows meta-analytic regression coefficients. The parameters for each sample and an equivalent figure for the IPIP facets are reported in Supplement A (osf.io/f9hmg). Because orthogonal Big Five factors may make scale locations somewhat easier to interpret, a version of Figure 4 with such orthogonal factors is also reported in Supplement A (osf.io/f9hmg). The regression coefficients demonstrate the location of each scale within the Big Five and all scale location were readily interpretable.

As can be seen in Figure 4, the Big Five domains differ in their importance in describing the variance of the stand-alone scales. This is reflected in both the number of scales loading primarily on each factor and by the number of cross-loadings on each factor. By either of these metrics, Neuroticism was the most important domain and Openness the least important. Neuroticism had 16 of 52 primary loadings, 14 of which exceeded 0.5. In contrast, Openness had just 4 primary loadings, only 1 of which exceeded 0.5. Neuroticism’s importance was similarly stark in the cross-loadings: Of the 35 relevant

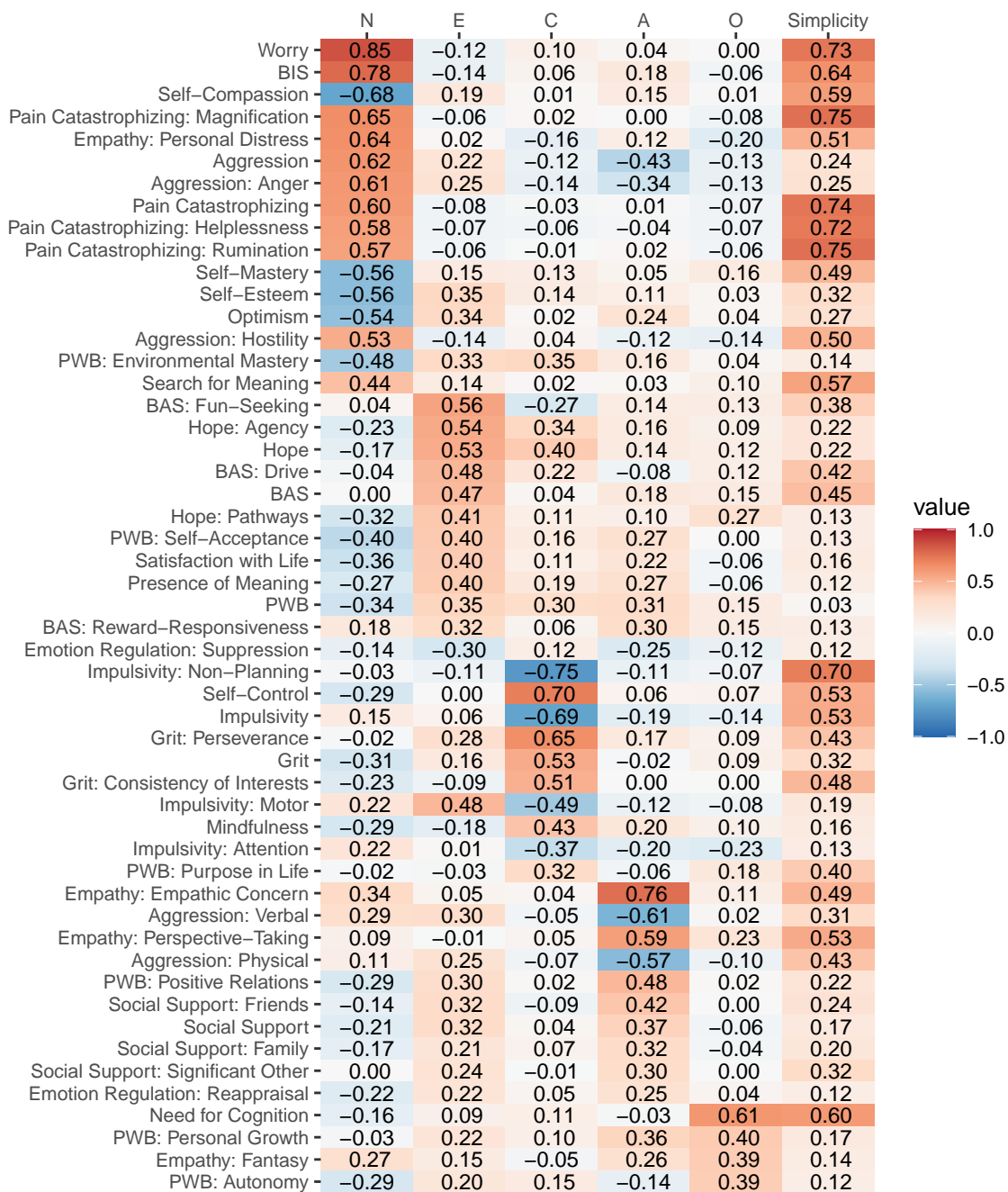


Figure 4. Stand-Alone Scales' Locations in the Big Five in Study 2.

Note: PWB = Psychological Well-Being; BAS = Behavioral Activation System Scale; BIS = Behavioral Inhibition System.

scales (i.e., all those whose primary loading was not on Neuroticism), 24 had at least a minor (> 0.15) secondary loading on Neuroticism. At the other end of the spectrum, Openness had just 8 scales with such secondary loadings of the 48 scales that did not load primarily on Openness.

Another notable insight from Figure 4 was the prominence of positive loadings on primary domains. This was particularly the case for Extraversion and Openness, which shared one negative loading between them, but was also apparent for Conscientiousness (the only negatively loadings were for Impulsivity and its facets, Spinella, 2007), Agreeableness (the only negative loadings were for Aggression facets, Bryant & Smith, 2001), and Neuroticism.

Figure 4 also indicates each scale's simplicity. Simplicity is a measure of interstitiality (or factor purity) and is inversely related to complexity (Kaiser, 1974). A simplicity of 0 indicates that a scale is evenly split between all factors and a simplicity of 1 indicates that it loads exclusively on one factor. We treat simplicity scores of greater than 0.5 as indicative of scales that are moderately purely located within a single domain.¹²

Unsurprisingly, a scale's simplicity tended to decrease as its loading on its primary domain decreased. There were also marked differences in the patterns of complexity by Big Five domain. Specifically, Neuroticism included many somewhat simple scales (10 of 16 with simplicity greater than 0.5)—including Worry and Pain Catastrophizing and its facets—and only had a handful of complex traits at lower primary loadings. Conversely, only five scales across the other four domains had simplicity levels exceeding the same threshold. The most extreme example of a dearth of simple scales was for Extraversion, where every single trait that loaded primarily on Extraversion was at least somewhat

¹² Kaiser (1974) created simplicity scores to evaluate indicators of factors rather than to determine the location of external constructs in factor space, so his interpretations of simplicity scores are not easily transferable to the current task. However, Kaiser (1974) suggested that simplicity scores between 0.5 and 0.6 are “miserable” indicators of a single factor, yet indicators of a single factor nonetheless. We therefore adopted 0.5 as a threshold for whether or not to consider a scale as relatively pure.

complex (i.e., simplicity less than 0.5), with either a strong secondary loading, or two or more moderate secondary loadings. The lack of simple scales on other domains was partly due to the prominence of cross-loadings on Neuroticism.

As one might expect, some of the more complex scales were complex by virtue of the fact that their overlap with the Big Five was modest (e.g., both facets of Emotion Regulation). However, there were also relatively complex scales that overlapped strongly with the Big Five. For example, over 70% of the variance in Aggression and Psychological Well-Being was described by the Big Five, yet each of these scales loaded substantially across at least 3 domains. These and other examples suggest that many stand-alone scales are highly interstitial with respect to their location in Big Five space.

Interestingly, although the point estimate of the average simplicity across all stand-alone scales (0.36) was lower than that of the IPIP facets (0.42), the difference was *not* significant, $MD = 0.06$, 95% CI $[-0.02, 0.15]$, $t(69.3) = 1.43$, $p = .158$. The measured effect size was somewhat smaller than might have been expected given that the IPIP facets were designed to be relatively pure indicators of each of the Big Five domains whereas the stand-alone scales were not. Indeed, considering that a simplicity of less than 0.5 indicates a somewhat complex trait, facets tended to be at least somewhat interstitial. This finding may reflect the breadth of content covered by NEO versions of the Big Five facets (including the IPIP), which are intended to span a wide variety of facets within each domain. As a result, it is not so surprising that these are often not excellent indicators of single domains, particularly when using the short-form employed here.

Were There any Common Features of Peripheral Scales? When we inspected the collection of scales that failed to surpass the 27th facet criterion (i.e., those scales that failed to reach the first dashed line in Figure 3), we discovered two sets of features that may account for their apparent distinctiveness from the Big Five. First, many of these peripheral scales were comprised of items that began with “when” or “if,” indicating that some condition had to be fulfilled before the main clause of the item would

be relevant. The extreme case of this was for Pain Catastrophizing whose items all began with “When I’m in pain.” However, this also applied to the Emotion Regulation scales (83.3% of Reappraisal items; 50% of Suppression items, Gross & John, 2003); the Drive (75%) and Reward Responsiveness (80%) facets of Behavioral Activation System (Carver & White, 1994); and the Fantasy facet of Empathy (50% of items, Ingoglia et al., 2016). Second, many of these scale items included a common word (or synonym) that was either not in any other items or only rarely featured. For example, every Social Support item within each facet included the facet name or a synonym—the four family support facet items all contained the word “family” (e.g., “I can talk about my problems with my family”); the four friend support facet items contained the word “friends”; and the four significant other facet items all contained the phrase “special person.” Of these, only “friends” was included in any other item from any other scale we assessed and then only rarely. Other examples included the Consistency of Interests facet of Grit (“goals,” “projects,” “pursuits,” or “interests,” Duckworth et al., 2007) and the Search for Meaning scale (“purpose” or synonyms, Steger et al., 2006). If such conditional clauses or specific words rendered a scale more situationally specific compared to a typical, “relatively decontextualized” trait (McAdams & Pals, 2006), this could explain the lower relationships between these scales and the Big Five. For example, “When I’m in pain, I feel I can’t go on,” is perhaps less descriptive of one’s *typical* patterns of behavior and experience as opposed to how one responds to specific (and perhaps infrequent) circumstances. In comparison, the descriptor “I feel I can’t go on,” may assess a more generalized tendency related to depression, and align closely with Neuroticism in the space of the Big Five.

However, these features may not have made items more contextualized in all cases. For example, because “purpose” could be related to many different aspects of one’s life, the Search for Meaning scale (Steger et al., 2006) did not obviously evoke some contextual situation; at least no more than similar items from other scales (e.g., the Satisfaction with Life Scale, Diener et al., 1985), which were more closely related to the Big Five. This could

indicate that the inclusion of “purpose” or a synonym in every Search for Meaning scale item either created some method factor or that the scale captured meaningful variance not well-described by the Big Five. Conversely, there were a couple of scales with similar features to the peripheral scales that nevertheless were quite closely related to the Big Five. For example, the items of Self-Compassion (Neff, 2003) tended to use conditional clauses (66.7% of items), but the scale was well-described by the Big Five. However, our face reading of these items is that the conditional clauses are less limiting than is the case for the scales we found to be more peripheral to the Big Five. For example, we suspect responses to the full item “When something upsets me I try to keep my emotions in balance” would correlate very closely with responses to just the main clause (“I try to keep my emotions in balance”). If correct, Self-Compassion’s relationship with the Big Five are likely comparatively unaffected by the use of conditional clauses.¹³

Post Hoc Exploratory Analyses. To expand on our planned analyses, we also performed four exploratory analyses. First, we examined the correlations between each stand-alone scale and the IPIP facets to determine if any scales were virtually reducible to Big Five facets. Second, we examined incremental validity of both stand-alone scales and facets beyond the Big Five, to determine how much of a contribution the collection of scales could make to a common outcome measure relative to that of the Big Five facets. Third, we examined whether the prominence of loadings on Neuroticism might be explained by an evaluative factor confounding our results. Finally, we examined the degree to which our results were dependent on us having used the BFI-2 to assess the Big Five domains.

Correlations with Facets. Many of the stand-alone scales we assessed appear very similar to Big Five facets—especially in terms of their R^2 values when regressed on the Big Five. A further way to examine the degree to which such scales can be treated as Big Five

¹³ The Purpose in Life facet of Psychological Well-Being (Ryff & Keyes, 1995) was also in the peripheral category and did not include common words or conditional clauses. However, the three item version had poor reliability (0.47 and 0.50 in Samples 2a and 2b, respectively), suggesting it did not assess a strong common theme, making its low R^2 difficult to interpret.

facets is to simply examine correlations between the stand-alone scales and each of the IPIP facets. Such an analysis cannot be exhaustive because there is no definitive list of all Big Five facets, but if any scales approach collinearity with a Big Five facet it would suggest that they can be reasonably labeled as facets themselves. Indeed, these analyses revealed that some scales were virtually reducible to Big Five facets. Table 3 shows the scales and facet combinations with absolute correlations greater than 0.9.

Table 3

Stand-alone scale and IPIP facet combinations with absolute correlations greater than 0.9

Scale	IPIP Facet	Correlation
Aggression	N: Anger	0.95 [0.91, 0.98]
Aggression: Anger	N: Anger	0.93 [0.90, 0.97]
BAS: Fun-Seeking	E: Excitement-Seeking	0.94 [0.89, 0.98]
BIS	N: Anxiety	0.90 [0.88, 0.93]
Grit: Perseverance	C: Achievement-Striving	0.99 [0.96, 1.00]
Impulsivity: Motor	C: Cautiousness	-0.93 [-0.98, -0.88]
Self-Esteem	N: Depression	-0.93 [-0.95, -0.92]
Worry	N: Anxiety	0.98 [0.96, 1.00]

Note: BAS = Behavioral Activation System; BIS = Behavioral Inhibition System; E = Extraversion; C = Conscientiousness; N = Neuroticism.

Interestingly, some of the scales included in the table did not stand out as especially Big Five related when considering their R^2 with the Big Five as reported in Figure 3. For example, the Fun-Seeking facet of the BAS (Carver & White, 1994) was correlated with the Excitement-Seeking facet of Extraversion at 0.94, despite an R^2 of just 0.41 when regressed on the BFI-2 factors. This placed it in the Peripheral category, illustrating the restrictiveness of the criteria we employed.

Incremental Validity. As discussed earlier, if a scale is narrower than a Big Five domain, and very closely related to a given outcome, then it will likely predict that outcome over and above the Big Five—i.e., it will show incremental validity. Although this is not indicative of a scale’s independence from the Big Five, is nevertheless informative.

First, it can help to determine whether a scale's relationship with the outcome is mostly due to re-packaged Big Five variance or instead whether it captures a moderate amount of variance not described by the Big Five at the domain level, perhaps representing an instance of the bandwidth-fidelity trade-off. Second, incremental validity analyses can be used to examine whether variance not described by the Big Five is relevant for theoretically or practically important outcomes. Finally, it provides another opportunity to examine whether our collection of highly-cited scales show similar patterns of incremental validity to Big Five facets, which would further support the claim that the collection of scales can be reasonably treated as facets of the Big Five themselves. We therefore performed incremental validity analyses with the present datasets.

Because these analyses were exploratory, we did not have a pre-identified outcome measure in our survey. However, one of our stand-alone scales is very commonly assessed as an outcome in well-being research—Satisfaction with Life (SWL, Diener et al., 1985; e.g., Christopher & Gilbert, 2010; Erdogan et al., 2012; Wood et al., 2008). Therefore, we used this scale as our outcome for all incremental validity analyses. The models used to assess incremental validity were very similar to our primary models with the exception that the outcome was always SWL and each model included the BFI-2 ESEM factors and one stand-alone scale (or IPIP facet) as predictors. As for the primary models, the 2-stage estimation procedure was employed for the stand-alone scales and SWL. A significant regression coefficient for the stand-alone scale was interpreted as incremental validity and changes in R^2 values from the models with just the Big Five predicting SWL were computed. Additionally, instead of using the bi-factor measurement model for multifaceted scales, single factor models with correlated residuals were used to avoid complications of how to relate group factors to the outcome (see Supplement A for further details; osf.io/f9hmg). As before, we meta-analyzed results across all the samples within which each scale was included.

Many scales had incremental validity when predicting SWL, which *prima facie*

suggests they may capture something of interest beyond the Big Five domains. However, the changes in R^2 were typically small. For example, Self-Compassion (Neff, 2003)—which has been argued to have incremental validity beyond the Big Five for predicting SWL (Neff et al., 2018; Geiger et al., 2018; cf. Pfattheicher et al., 2017)—did indeed provide this incremental validity, $b = 0.25$, 95% CI [0.03, 0.47], $p = .028$, but, despite being correlated with SWL at 0.60 (in the meta-analysis), adding Self-Compassion to the Big Five in predicting SWL increased the R^2 by just 0.02. Thus, although self-compassion did provide incremental validity beyond the Big Five at predicting SWL, most of its relationship with SWL was simply re-packaged Big Five variance.

In contrast, a scale adjacent to Self-Compassion in Figure 3—Self-Esteem (Rosenberg, 1965)—had a one of the larger R^2 changes. Like Self-Compassion, Self-Esteem provided incremental validity beyond the Big Five, $b = 0.76$, 95% CI [0.60, 0.93], $p < .001$. However, in contrast to Self-Compassion, Self-Esteem accounted for 19% additional variance of SWL when added to the model with just the Big Five factors. This suggests that, in addition to the variance it shared with the BFI-2 factors, Self-Esteem also assessed something unique to these factors. Crucially, however, this was also the case for a number of the IPIP facets. The change in R^2 when adding the Cheerfulness facet (a facet of Extraversion) was 0.16, and the change in R^2 when adding the Depression facet (a facet of Neuroticism) was 0.10, suggesting that these facets also assessed something unique from the Big Five factors that could be of interest when predicting SWL. Moreover, as noted in Table 3, Self-Esteem was correlated with the Depression facet at -0.93 . Taken together, these observations suggest that this facet and Self-Esteem were both tapping the same variance not captured by the Big Five factors, and that both cases represent instances of the bandwidth-fidelity trade-off, but not that they measure something “beyond” the Big Five.

A few other scales also demonstrated incremental validity beyond the Big Five for predicting SWL with a change in R^2 greater than that of all the IPIP facets. However, all of these examples assessed some construct closely connected to well-being, of which SWL is

a central measure (Diener et al., 1985; Ryff, 1989), even being a component of Subjective Well-Being (Emmons & Diener, 1985). We would therefore expect high correlations between these well-being-related scales and SWL and we would expect moderate incremental validity beyond the Big Five, given that the Big Five domains assess broad features of personality, and are not intended to assess well-being. And indeed, all of the scales that predicted a change in R^2 greater than that of the largest IPIP facet were correlated with SWL at greater than 0.8. These cases therefore represent prototypical examples of the superior fidelity for assessing a particular outcome, but do not challenge the notion that these scales can be located within the Big Five (as noted in the Introduction).

A final example to consider is that of Social Support (Zimet et al., 1988). Social Support was categorized as Peripheral to the Big Five (see Figure 3) and demonstrated incremental validity beyond the Big Five, $b = 0.44$, 95% CI [0.36, 0.52], $p < .001$, with a moderately large change in R^2 (0.11). The change occurred despite a somewhat lower correlation with SWL (0.68) than other scales with substantial R^2 changes. Thus, if our categorization of Social Support as Peripheral to the Big Five is correct, it may not merely be an instance of the bandwidth-fidelity trade-off, but perhaps captures important variance that is separable from the Big Five.

Evaluative Bias. To control for evaluative bias, a single factor upon which all items were allowed to load was added to each model. Details of the model employed for this analysis, the results, and some discussion of some complications involved are presented in Supplement A (osf.io/f9hmg). The results were similar to those presented in the primary analyses. The average R^2 of the stand-alone scales was 0.47, 95% CI [0.42, 0.52], which was not significantly different from that of the primary models (0.51). Moreover, just 4 (of 260) regression coefficients changed by a magnitude of 0.2 or greater and just 6 (of 52) scales changed their primary loading. Of these 6, half were due to rearranging which domain for an interstitial scale was primary, and only 3 scales had prominent location changes. The most extreme of these was Search for Meaning, which changed from loading relatively

purely on Neuroticism to primarily loading on Openness with a small but important cross-loading on Neuroticism. The addition of the evaluative factor increased the simplicity of the scales by 0.04 to 0.40. Otherwise, the overall pattern of results remained very similar, suggesting that the primary results were relatively unaffected by evaluative bias.

IPIP Factor Models. To gauge the robustness of our findings, we specified an alternative series of models in which the IPIP factors predicted the stand-alone scales in place of the BFI-2. Likely due to the IPIP having a broader assessment of facets and twice as many items as the BFI-2, the average meta-analytic R^2 of these models was 0.63, 95% CI [0.58, 0.67], compared to 0.51 for the BFI-2 models.¹⁴

The IPIP facets were used to generate criteria as before, but for each facet, its items were dropped from the ESEM used to estimate the Big Five factors. The average R^2 of the IPIP facets when predicted by these modified IPIP factors was 0.59, 95% CI [0.53, 0.65], compared to 0.64 for the BFI-2 models, and the criterion for the 27th facet was 0.40, compared to 0.43 for the BFI-2 models. Given the higher average R^2 of the scales and lower criterion, 84.6%, 95% CI [72.5%, 92.0%], of scales surpassed the R^2 of the 27th facet. The higher proportion was at least partly due to dropping the content related to each facet from the factors' estimation in the generation of the criteria; however, only three scales (5.8%) had a higher R^2 when predicted by the BFI-2 factors than by the IPIP factors, suggesting that the IPIP factors at least did similarly well at describing the variance of the stand-alone scales. Therefore, this post hoc analysis again suggests that most stand-alone scales can be reasonably located within the Big Five, providing some assurance that our primary results generalize beyond the BFI-2 as a measure of the Big Five domains. Further details of these analyses are reported in Supplement A (osf.io/f9hmg). Parameter estimates and pattern matrices for these models are reported in Supplement E ([osf_link](#)).

¹⁴ Models with IPIP factors predicting the stand-alone scales were pre-registered (aspredicted.org/ik33u.pdf; aspredicted.org/az42w.pdf), but we did not specify criteria to categorize scales from these models. The criteria (described in the next paragraph) were developed post hoc, which is why these analyses are reported in this section.

Summary

In support of the findings from Study 1, Study 2 demonstrated that a sizable majority of stand-alone scales were as closely related to the Big Five as at least four of 30 Big Five facets, and roughly half were as closely related as at least 10 facets. Post hoc analyses also demonstrated that some scales were correlated very highly with Big Five facets; that results were likely not overly influenced by an evaluative factor or the choice of Big Five questionnaire; and scales only demonstrated greater incremental validity at predicting SWL than Big Five facets when they were very closely related to the outcome.

Unlike in Study 1, we selected scales in a manner that was blind to their overlap with the Big Five—based on their number of recent citations. Although obviously not highly representative of the universe of trait scales, there is also no strong reason to expect this criterion to produce scales with particularly high (or low) degrees of connections to the Big Five (discussed further, below). For this reason, the results of Study 2 provide particularly compelling evidence for the applicability of the Big Five as an organizing framework for psychological trait scales.

General Discussion

Taxonomic frameworks are of immense value to integrative and cumulative science. In personality psychology, many consider the Big Five a taxonomic framework that can usefully organize the universe of trait constructs (e.g., John et al., 2008). Surprisingly, however, there has been little empirical evaluation of this possibility for stand-alone scales. The primary aim of the present research was to assess how effectively the Big Five could act as an organizing framework for stand-alone psychological trait scales (RQ1). We assessed this claim by examining how much of each of these scale's variance was described by the Big Five, relative to that of facet scales from an alternative Big Five questionnaire. Additionally, we examined the locations of the scales within the Big Five framework (RQ2).

Results broadly support the claim that the Big Five provides a useful organizing framework of traits for personality psychology, and psychological science more broadly, with a majority of scales being reasonably labeled as Big Five facets with readily interpretable locations.

RQ1: How Effective is the Big Five as an Organizing Framework for Stand-Alone Trait Scales?

To answer RQ1 we needed to solve two problems. First, because practical considerations prevent readily assessing relations between the Big Five and the entire universe of available scales, we needed a means to draw a relatively unbiased set of scales from this extensive population. We decided to select scales based on citation counts, reasoning that this method would not favor scales that are related to the Big Five and would ensure that the scales examined were influential in the field. Second, we needed to establish a compelling and impartial criterion for deciding whether or not a stand-alone scale can be located within the Big Five. Previous suggestions for how to decide whether a scale could be located within the Big Five were conspicuously arbitrary. To provide a more objective solution, we derived a criterion based on the variance that the Big Five domains share with scales that are already accepted as being located within this framework—the lower-level facets of the Big Five. More specifically, we reasoned that any scale that was as closely related to the Big Five as the 27th facet (of 30 as ordered by R^2) could be said to lie within the Big Five. Applying this criterion to our results, we found that 83.3% of scales that we had selected because we expected them to be at least moderately related to a Big Five domain (Study 1) could be located within the Big Five, and, more compellingly, this proportion decreased only modestly, to 71.2%, when we “blindly” selected scales based only on citation counts (Study 2). We took these findings to indicate that the Big Five appears to be a useful organizing framework for most such scales.

It is immediately apparent that our conclusion is starkly different to that of Paunonen and Jackson (2000), who concluded that “plenty” lies beyond the Big Five, even

though their criterion was more inclusive than ours¹⁵. However, this can be attributed to their very different approach to sampling trait terms. Specifically, by reanalyzing Saucier and Goldberg's (1998) data, they examined trait-words typically not included in Big Five. That is, Paunonen and Jackson (2000) pointedly focused on a collection of traits that were comparatively unlikely to be closely related to the Big Five. Had we attempted to find scales we thought least likely to be related to the Big Five, our conclusions may have been similar to theirs. It is noteworthy, however, that the stand-alone scales which were comparatively independent from the Big Five in our own analysis do not obviously systematically connect to the adjectives considered by Paunonen and Jackson (2000) to be independent of the Big Five. Instead, the stand-alone scales we observed to be comparatively independent of the Big Five seemed to owe that comparative independence to other factors, considered below.

How Should the Variance not Described by the Big Five be Interpreted?

Although our results suggest that a majority of stand-alone scales can be located within the Big Five, all scales had some variance not described by the Big Five and some scales had a sizable share of variance not described by the Big Five. Some of this unexplained variance could be due to method factors that may have artificially reduced observed R^2 values (Podsakoff et al., 2003) or some may have been due to contextualized items (as discovered in our analysis of the items of Peripheral scales) resulting in a large distinction from the broad-bandwidth Big Five factors. It is also likely that alternative Big Five questionnaires to the ones we used would have explained somewhat more variance, given the IPIP factors explained substantially more variance than the BFI-2 factors. However, in the case of scales with moderate or high R^2 with the Big Five (e.g., surpassing the 27th facet criterion), the variance not described by the Big Five may be reasonably explained by the bandwidth-fidelity trade-off.

¹⁵ On the other hand, whereas we used latent variables to adjust for unreliability, they did not. Failing to correct for unreliability may have made their constructs seem more independent from the Big Five, despite the more lenient criterion.

As described earlier, the bandwidth-fidelity trade-off describes how narrower traits, with higher “fidelity,” are likely to predict closely related constructs more strongly than broader, high “bandwidth” traits that predict a wider variety of outcomes. In order for a narrow scale to better predict a closely related outcome than its broader counterpart, it cannot be completely reducible to the broad measure. Thus, broad bandwidth measures of the Big Five domains cannot possibly be expected to describe the entire variance of any narrower bandwidth stand-alone scale, especially those with incremental validity beyond the Big Five.

It is also crucial to recognize that Big Five facets are narrower assessments than the Big Five domains, and likewise had substantial shares of their variance *not* explained by the Big Five. For example, in our data the average R^2 of IPIP facets was 0.64. As a result, Big Five facets would also be expected to have a fidelity advantage when predicting closely related outcomes, as we and others have observed (Anglim et al., 2020; e.g., Danner et al., 2020). Thus, incremental validity should not be taken to indicate that the scales and facets cannot be located within the Big Five, nor should the presence of variance not explained by the Big Five be taken to indicate that it is not useful as an integrative framework for psychological trait scales.

On the other hand, the presence of Peripheral scales in our research—particularly those which were truly peripheral, with lower R^2 than the least-related Big Five facet—poses a stronger challenge to using the Big Five as an integrative framework. These scales had sizable shares of their variance *not* described by the Big Five, and this unexplained variance may well sometimes be meaningful, as in the case of Social Support). When this unexplained variance is demonstrated to be meaningful, it would be reasonable to regard such scales (like those identified by Paunonen & Jackson, 2000) as somewhat independent from or peripheral to the Big Five.

Nevertheless, the existence of such scales need not prove a significant challenge to the

Big Five, which was designed to capture the *major dimensions* of psychological traits. The issue is thus a matter of degree: If a sufficiently large collection of scales seemed to be mostly independent from the Big Five, then its effectiveness as an organizing framework could rightly be called into question. Alternatively, were the Big Five to exclude a major dimension of personality (or a major dimension's worth of variance spread across multiple domains—as argued by advocates for the HEXACO, e.g., Ashton & Lee, 2005a, 2018; Lee & Ashton, 2019) then this would also be a telling criticism. Instead, the results presented here suggest that relatively few scales measure something moderately independent from the Big Five, and that most scales might reasonably be treated as facets of the Big Five (discussed further below). Although it is possible that an alternative framework (such as the HEXACO; see below for further discussion) would have performed even better, we can nevertheless conclude that the Big Five offers an effective organizing framework for the population of commonly used, stand-alone psychological trait scales.

RQ2: Where are the Stand-Alone Scales Located within the Big Five?

The second goal of the present project was to identify the locations of the stand-alone scales used in this research within the space described by the Big Five. These were presented in Supplement A for Study 1 and Figure 4 for Study 2. We now turn to some implications of these findings.

In the Study 2 results section we noted the relative importance of Neuroticism and the relative *unimportance* of Openness. The importance of Neuroticism is surprising given that, within lexical research, Neuroticism is typically the fourth most important domain (Peabody & Goldberg, 1989), and Neuroticism-related words are the fourth most common in the English lexicon (Goldberg, 1990, 1992). In contrast, the unimportance of Openness is in line with the fact that it has both the fewest words in the English lexicon (Goldberg, 1990, 1992) and explains the least variance in participants' responses (Peabody & Goldberg, 1989). That said, the relative lack of importance here is considerably more

exaggerated than in lexical studies.

These patterns of relative importance were probably not due to our exclusion criteria, which did not result in fewer exclusions of scales related to Neuroticism nor more exclusion of scales related to Openness compared to the other Big Five domains. Of the top 9 excluded scales (by citations; see the list on the OSF; osf.io/f9hmg), 7 assessed depression, anxiety, stress, and burnout—constructs likely to have been primarily aligned with Neuroticism—suggesting that, if anything, our exclusion criteria resulted in an *under-representation* of Neuroticism scales in our results. Instead, the differences in importance may have been due to differences in the prominence of fields that use each domain's scales. Specifically, Neuroticism's dominance may have been due to the prominence of psychiatry and clinical psychology¹⁶, which may disproportionately create, use, or cite scales that are closely related to Neuroticism. Similarly, the dearth of Openness-related scales may have been due to the relative size of fields that assess constructs related to Openness, with fewer citations as a result. A notable exception to this rule would be that of intelligence and cognitive ability, which have been argued to be part of Openness (DeYoung et al., 2012, 2014). However, neither intelligence nor cognitive ability tests passed our inclusion criteria. Alternatively, the breadth of the Openness domain—as indicated by both the collection of traits that fall within openness (DeYoung et al., 2012; Kaufman, 2013) and the difficulty in identifying a label that fully captures the domain's content (De Raad, 1994)—may mean that scales connected to Openness are typically less closely related to each other and, consequently, less likely to be included in the same studies. If true, then Openness-related scales would receive fewer citations as a result. Overall, because we selected scales in Study 2 by citations, differences in the number of primary loadings by domain in Figure 4 may have reflected the prominence of

¹⁶ The prominence of these fields was confirmed with the aid of Clarivate's InCites tool (incites.clarivate.com). According to Clarivate, 145,411 psychiatry and clinical psychology papers were published between 2015 and 2017, compared to 207,716 papers in the same period for all other fields of psychology.

the various research fields that use particular collections of stand-alone scales. Importantly, this likely had a minimal effect on our broad conclusions as we discuss further below.

We also noted the prominence of positive loadings on primary domains. This was surprising given that the scales assessed were not created with any specific concern for their relationships with the Big Five. However, the prominence of these loadings appears to reflect the distribution of words in the English lexicon. Examining Table 1 of Goldberg (1990) revealed that the poles of each Big Five domain with more stand-alone scales has more associated words than the opposite pole for four of the Big Five domains: the positive pole of Openness, Extraversion, Conscientiousness, and Neuroticism had 91%, 72%, 33%, and 21% more words than the negative pole, respectively. Contrary to this pattern, the same table shows the pole representing *low* Agreeableness was represented with 33% more words than its opposite, in contrast to the predominantly positive loadings in our Study 2 results. Future work might reveal whether a larger selection of stand-alone scales would align the balance of positive versus negative loadings for Agreeableness with Goldberg (1990)'s results. Thus, for at least four of the Big Five domains, the prominence of positive loadings appears to reflect patterns in the English lexicon, providing further support that stand-alone scales and the Big Five broadly assess the same universe of constructs.

Interstitial traits and their implications. We observed an unequal distribution of interstitial traits between domains. Outside of Neuroticism, only a handful of scales were moderately simple (as indicated by a simplicity score greater than 0.5), none of which loaded primarily on Extraversion. As shown in Figure 4, this was principally due to cross-loadings on Neuroticism, and, as demonstrated by our follow-up analyses, this effect could not be readily accounted for by evaluativeness, as the preponderance of cross-loadings on Neuroticism remained when we included an evaluativeness factor (although simplicity did increase marginally). Another possibility is that more neurotic individuals rate themselves more negatively on otherwise unrelated trait scales (e.g., Fossum & Barrett, 2000). This *neurotic-content contamination* may be an undesirable

artifact, perhaps due to item wording choices, that would ideally be minimized in the assessment of the construct of interest. If this contamination is responsible for the large number of cross-loadings on Neuroticism, then it is possible that neurotic content has gone undetected in many scales within the corpus of psychological trait scales. Importantly, a failure to locate such scales within the organizing framework of the Big Five could partly explain why this problem might go undetected.

However, even if neurotic-content contamination explains why some scales are interstitial, this would still be only part of the story: Extraversion traits also frequently had substantial cross-loadings on Conscientiousness and Agreeableness; Agreeableness traits also frequently had substantial cross-loadings on Extraversion; and many of the cross-loadings on Neuroticism seemed plausibly due to a legitimate relationship with Neuroticism rather than simply due to some bias (e.g., Empathic Concern, Ingoglia et al., 2016; SWL, Diener et al., 1985; and Verbal Aggression, Bryant & Smith, 2001). These observations suggest that the presence of interstitial traits is quite common and is not simply due to items unintentionally assessing content related to conceptually unrelated constructs.¹⁷

Importantly, the existence of interstitial traits is entirely consistent with foundational lexical research underpinning the Big Five (e.g., Ostendorf & Angleitner, 1992; Tupes & Christal, 1992, 1961). For psychometric reasons, Big Five questionnaires do not assess interstitial facets, and the Big Five is often depicted as a simplified tree-like structure, with domains branching into aspects that in turn branch into facets and then nuances (Möttus et al., 2017), etc. [e.g., DeYoung2015a]. But this is not literally how personality

¹⁷ Our methods and criterion for determining which traits were interstitial may have exaggerated their presence, however. In our analysis the factors were defined by a Big Five questionnaire and the scales were then located within that framework. In contrast to early lexical research (and, indeed, any research employing traditional factor analysis), our method could not eliminate noisy cross-loadings with slightly different rotations. Thus, the presence of interstitial traits may have been over-reported in our results. Nevertheless, even with a much lower criterion for determining simplicity (e.g., if it were reduced from 0.5 to 0.4), the number of interstitial traits was still substantial and seems unlikely to be easily explained away by methodological concerns.

psychologists understand the Big Five, which is frequently presented in a manner that makes this complexity explicit (Bucher & Samuel, 2020; e.g., the Abridged Big 5 Circumplex model, Hofstee et al., 1992; or the BASS-Ackwards method, Goldberg, 2006). Indeed, the Big Five is not strictly hierarchical, but is most precisely described as a *quasi hierarchy* (Digman, 1997) or *heterarchical* structure with some facets located in interstitial locations between two or more domains.

Simplified tree-like hierarchical representations of the Big Five risk creating the false impression that a scale with no strong loadings on any single domain is largely independent from the Big Five. Yet results presented here demonstrated that scales can have a high R^2 with the Big Five, despite having no strong loadings on any single domain (e.g., Psychological Well-Being, see Figures 3 and 4). Focusing on the representations of the Big Five that acknowledge this complexity, rather than a single, categorical classification within a particular domain, may serve as a reminder that the Big Five are not five “buckets” within which small collections of traits can be placed.

An alternative interpretation of the presence of interstitial traits is that the Big Five may not optimally reflect the variance of many stand-alone scales. More precisely, although the Big Five can adequately describe the variance of the stand-alone scales, they may not organize these scales optimally. Analogously, early biological taxonomies organized species based on function or appearance, and could approximately describe the collection of all but a few species (with noteworthy exceptions such as the Platypus, which was initially considered a fake; Moyal (2004)). Although modern biologists prefer a genetically-based taxonomy, the early taxonomies were nevertheless useful, permitting such advances as Darwin’s theory of evolution by natural selection. Similarly, even if the Big Five does not represent an optimal descriptive taxonomy of psychological traits, it has nevertheless facilitated the development of personality theory (e.g., as noted in the introduction, Cybernetic Big Five Theory, DeYoung, 2015; the evolution of personality traits, Nettle, 2006). Furthermore, as we have now demonstrated, it can likely describe a moderate

amount of variance for many of the hundreds of stand-alone scales currently employed largely in the absence of an organizing framework. With these benefits in mind, we propose that the Big Five can be an effective taxonomy of stand-alone scales, so we hope it (or potentially the HEXACO, as discussed below) will be treated as such by scale developers and users until and unless some other model proves superior.

Further Considerations

How Reasonable Was Our Criterion? Our empirically-derived criterion was more stringent than those proposed in the earlier literature, and made particularly stringent by allowing three Big Five facets to be regarded as “peripheral” to the Big Five. Proponents of the Big Five could justifiably object to our criterion given that the IPIP facets are, by definition and design, part of the Big Five. By such an argument a better criterion may have been based on the 30th facet. Were such a criterion used 87% of stand-alone scales would have been located within the Big Five. However, we maintain that our decision was prudent, as it allows for a degree of imperfection in the specification and measurement of the Big Five facets. Had we instead used some weaker criterion then our conclusions would have been vulnerable to the possibility that a couple of the IPIP facets were poorly chosen as part of the Big Five or invalidly assessed.

Can we Generalize Beyond our Selection of Scales? The value of the present findings is not to say that our particular collection of scales can be located within the Big Five, but that this is likely to be true for the broader population of stand-alone scales. Because our scales for Study 1 were selected with their relationships with the Big Five in mind (to provide “proof-of-concept”), we had little reason to suppose that those results would generalize to the broader population of stand-alone scales. For Study 2, however, we selected scales exclusively based upon number of citations on the assumption that such citation counts would be unrelated to scales’ connectedness to the Big Five. So, how reasonable was this assumption?

Consider an alternative but still practical approach where all scales published within a particular time period were selected instead of highly cited scales. How would these different selection methods differ? First, scales that are redundant with previously established measures are presumably less likely to become highly cited unless the new scale is superior in some way. Thus, if a stand-alone scale seems likely to assess the same construct as a Big Five domain, it is perhaps less likely to become highly cited than another measure. Such a trend has not been absolute (e.g., Grit, Duckworth et al., 2007, is a possible exception; Credé et al., 2016; Schmidt et al., 2018), but may have resulted in fewer scales very closely related to the Big Five being selected with our method. If so, then had we selected scales based on time period, we may have observed a lower average R^2 for our highly cited scales than for the full population of scales.

Second, if the Big Five assesses particularly important constructs then those scales that are more closely related to the Big Five may become highly cited more frequently than scales less closely related to the Big Five. The predominance of scales closely related to Neuroticism may be an example of such an occurrence. If true, then selecting scales based on citation counts may have resulted in somewhat higher R^2 values than if we had used a particular time period to select scales. Thus, this potential issue may have biased our results in favor of the Big Five somewhat, but only if the Big Five domains are comparatively important in the universe of psychological trait constructs. However, if this were the case, then it would itself suggest that the Big Five can provide an effective organizing framework for this universe.

Finally, if scales without major limitations (e.g., poor item wording, reliability, or validity) are more likely to be used by researchers, then selecting scales based on time periods rather than citation counts would likely result in a collection of lower-quality measures than we had in our citation-count-based Study 2. This could make interpreting results more difficult if low R^2 values were due to idiosyncratic item wording or poor reliability. If our selection method resulted in a relatively reliable and valid collection of

scales compared to the population of stand-alone scales, then that can only be considered a positive of our selection method.

Although any of these concerns may have had some effect on the average R^2 of our Study 2 results, it seems unlikely that the impact would have been sufficient to substantively change our results, as compared to those based on some alternative, impartial method to select scales. Study 2 results thus appear reasonably likely to generalize to the population of stand-alone psychological trait scales.

Can we Generalize Beyond our Present Samples? Because none of our samples were stratified or representative samples, we cannot guarantee that our results generalize beyond Australian university students or American MTurk workers. Nevertheless, because our samples differed markedly on a number of demographic factors (age, ethnicity, student status, etc.), yet yielded similar findings, our results seem reasonably likely to generalize beyond our particular samples. Additionally, there is evidence that using convenience samples does not distort how personality relates to other constructs (Burnham et al., 2018; Vitriol et al., 2019).

One reason we are confident that our results would generalize reasonably well to other samples is that each of the samples we used partially acted as its own control. Specifically, with each study we obtained the R^2 values not only for the stand-alone scales but also for the IPIP facets that were used to determine the criteria values for each sample. Had any of our samples differed systematically from the general population in a way that affected self-reporting (such as superior or inferior levels of self-insight, attentiveness, or verbal comprehension, etc.), this would affect the R^2 values not only for the stand-alone scales but also for the IPIP facets. Because our inferences about the Big Five locatability of stand-alone scales refers not to study-independent statistical values (e.g., an R^2 of .09 or .20) but to values determined within the context of each sample (e.g., the R^2 of the 27th IPIP facet), our inferences should be expected to generalize to other sample types and populations considerably better than most studies.

The Big Five or the HEXACO?. One framework that has been proposed as an alternative to the Big Five is the HEXACO (Ashton & Lee, 2007, 2020; Lee & Ashton, 2004). Three HEXACO domains are largely unchanged from the Big Five (Ashton & Lee, 2007; Ludeke et al., 2019) and scales that had their primary loading on any of those domains would likely have their primary loading on the same domain in both frameworks. However, the HEXACO has one more factor than the Big Five and, in some circumstances at least, describes nearly one factor's worth of additional variance (Ashton & Lee, 2018; Lee & Ashton, 2019), so it is plausible that the HEXACO would describe a moderate amount more variance of the stand-alone scales than the Big Five. Thus, there seems no reason to expect stand-alone scales to be *less* related to HEXACO than was observed here for the Big Five.

However, if a goal of a taxonomy of psychological traits is to divide the variance relatively cleanly, then one area where the Big Five appeared to do this comparatively successfully was for scales closely related to Neuroticism, where many were quite simple (e.g., Pain Catastrophizing, Sullivan et al., 1995; and Worry, Meyer et al., 1990). It would be interesting to see how this multitude of Neuroticism scales in Study 2 translates into the HEXACO where Big Five Neuroticism is spread across HEXACO Agreeableness, Emotionality, and Extraversion (Ashton & Lee, 2007; Ludeke et al., 2019). On the other hand, scales such as the Anger facet of Aggression (Bryant & Smith, 2001)—here split between Neuroticism, Extraversion, and low Agreeableness in both studies—would likely be better represented in the HEXACO where the Agreeableness factor includes anger at its negative pole. In any case, it remains an open question whether the Big Five or the HEXACO can explain more of the variance of collections of stand-alone scales, and which parcels that variance more neatly. However, it is unlikely that such results will be overly compelling in the Big Five versus HEXACO debates, given the population of stand-alone scales was not created objectively.

Importantly, however, the HEXACO and Big Five were both created from the lexical

tradition. Advocates of both frameworks agree that this is an effective way to learn about the structure of personality traits (Ashton & Lee, 2005b; Saucier & Goldberg, 1996). Thus, taking a broader perspective on the present research, although it explicitly tested the Big Five, it implicitly tested the efficacy of the lexical tradition to produce a framework that could describe the broad dimensions of personality by examining measures created outside this tradition. In this regard, it may be taken as broad support of any lexical based personality framework including both the Big Five and the HEXACO.

Are Many Stand-Alone Scales Big Five Facets? Many scales were as well-described by the Big Five as at least a few Big Five facets and some were correlated with facets to the point of redundancy. Although some scales, otherwise well-described by the Big Five, appeared interstitial between two or more domains, Big Five facets were also sometimes similarly interstitial (e.g., see Figure A4, Supplement A; osf.io/f9hmg), and our earlier discussion of the Big Five as heterarchical should have made it apparent that facets can reasonably be interstitial while still being readily located within the Big Five. Our results therefore suggest that many stand-alone scales might reasonably be treated as Big Five facets themselves.

Our analyses on this topic were consistent with previous research that has made a similar case for particular scales. For example, as noted earlier, Credé et al. (2016) and Schmidt et al. (2018) argued that Grit (Duckworth et al., 2007) and especially the Perseverance facet should, at least, be considered facets of Conscientiousness and Grit authors themselves have accepted the facet classification (e.g., Duckworth et al., 2019). This was supported in our analyses where the full scale and the Perseverance facet had R^2 values of 0.57 and 0.68, respectively, when regressed on the Big Five, and the Perseverance facet was correlated with the Achievement-Striving IPIP facet at 0.99. Similarly, despite their disagreements, Pfattheicher et al. (2017), Geiger et al. (2018), and Neff et al. (2018) all report absolute correlations between Self-Compassion (or lower level factors thereof) and Neuroticism (or its facets) of 0.75 or greater, which was similarly large to correlations

between different versions of Neuroticism (Soto & John, 2017). It therefore seems reasonable to at least count Self-Compassion as a facet of Neuroticism. Again our results matched these findings: Self-Compassion had an R^2 of 0.67 (multiple r of 0.82) when regressed on the Big Five and was moderately purely located within Neuroticism (see Figure 4. Yet, Grit and Self-Compassion seemed pretty typical among our collection in Figure 3. Moreover, as noted above, the Fun-Seeking facet of the BAS (Carver & White, 1994) was classified as Peripheral to the Big Five, but was very highly correlated (0.93) with a the Excitement-Seeking facet of the Big Five. This is consistent with previous research that found a close connection between BAS and Extraversion and Fun-Seeking with Excitement-Seeking (Heubeck et al., 1998; Segarra et al., 2014). These collection of findings suggest that most scales we assessed, especially those surpassing the R^2 of the 27th facet, should be considered facets of the Big Five.

Recommendations

Given that the Big Five appears to be an effective taxonomy of stand-alone trait scales, what does this mean for the assessment of personality traits? We propose a solution that we call “integrative pluralism.” If a scale shares a similar amount of variance with the Big Five as a typical Big Five facet, then, as argued earlier, it should be labeled as such. Such labeling recognizes that the scale can be considered part of the Big Five, without implying that it is redundant or should be discarded. As with other Big Five facets, the scale may assess some variance that was not well captured at the domain level—moreover, it may capture variance that was not well described by any existing Big Five facet. We assessed incremental validity for just one outcome and discovered a few scales that seemed likely to assess something of interest in predicting the outcome that was not captured by the Big Five domains. Additional outcomes would likely identify additional such scales. Thus, we suggest a pluralistic approach whereby stand-alone scales coexist with the Big Five and are treated as useful assessments for outcomes they provide incremental validity

at predicting.

On the other hand, scale developers and users should also be expected to locate each new and existing scale within (or peripheral to) the Big Five using methods such as we apply here. Additionally, if a scale has measurement, validity, or reliability concerns then alternative assessments should be employed or created. Moreover, if a scale appears to be redundant with a Big Five facet or facets—such as Worry (Meyer et al., 1990) and IPIP Anxiety—then the burden of proof would seem to reasonably lie with its users or developers to make a case for its superiority to the facet in terms of validity, reliability, or efficiency (e.g., fewer items for equally good measurement) when using such scales. Finally, and most importantly, the present research has demonstrated that a sizable share of most stand-alone scales' variance can be described by the Big Five. Thus, research using these scales ought to explicitly consider the links between the scale and the Big Five, pertinent findings from the relevant trait space should be explicitly discussed, and claims to novelty and theoretical significance must be evaluated with respect to this broader nomological network. In short, the pluralistic use of stand-alone scales should be integrated into the Big Five framework.

If the integrative pluralism approach were broadly adopted, how would research using stand-alone trait scales be affected? First, a primary benefit we imagine is that it would limit construct proliferation and Jangle Fallacies. Currently, scholars can create new scales, perhaps report correlations with the Big Five, and find incremental validity beyond some relevant measures predicting some important outcome. In some cases, these initial studies are sufficient to spark a research field using the new scale with limited consideration of the Big Five thereafter.¹⁸ If the scale ought to have been classified as a facet of the Big Five (Credé et al., 2016; such as for Grit, Duckworth et al., 2019; Schmidt et al., 2018), then

¹⁸ For example, a scale development paper for a mindfulness measure (K. W. Brown & Ryan, 2003) was cited around 3,500 times between 2015 and 2017—over a quarter of the total number of citations of the most popular Big Five assessments over the same period (as noted at the start of the paper). Of these, only around 525 (15%) include either “Big Five,” “Big 5,” “Five Factor Model,” or “FFM,” despite mindfulness being correlated with Neuroticism at -0.56 in the original paper and having an R^2 when regressed on the BFI-2 of 0.47 in our results (see Figure 3).

scale authors would have been required to consider previous research with the Big Five and the novelty of the new measure may have not been as stark as the creators first thought. In some cases, the utility of the scale may not be sufficient to justify its use in place of already established measures. In the current arrangement, such conclusions typically only occur after the popularity of scale is secured and it may take some time for the scale's popularity to wane once established.

We also hope the present work facilitates greater integration by somewhat reducing the incentives for obscuring or downplaying links between stand-alone scales and the Big Five. We have found such links are the rule, not the exception. Further, we found that even a measure highly connected to the Big Five could nevertheless provide substantial contributions to incremental validity for an important outcome. Scale users would thus be wrong to fear that substantial connections to the Big Five is a unique imperfection of their scale, or that such connections were necessarily fatal. Accurately contextualizing the stand-alone scale within the Big Five, and the study's findings within the broader pertinent literature, can result in meaningful, scientifically honest research, even for traits readily recognizable as Big Five facets.

Of course, the goal of the present research was to demonstrate that the Big Five would make *an* effective organizing framework for stand-alone scales, not that it would be *the best* organizing framework. Indeed, as argued above, it is likely that the HEXACO—also developed within the lexical tradition—would be similarly effective. Pending future research to test the HEXACO's efficacy, we suggest that researchers use whichever framework would be most appropriate for their particular research question [Srivastava (2020); Zhao2020].

Conclusion

Reflecting on the state of the personality literature prior to the ascendancy of the Big Five, McAdams and Pals (2006) noted how a prominent text on personality came to organize its content (London & Exner, 1978): “In explaining why they arranged their chapters in alphabetical order... the editors wrote that no reasonably less arbitrary organizational scheme seemed to exist” (p. 208). This powerfully illustrates the value of an organizing framework for the universe of psychological traits. The Big Five was viewed by many to provide such a framework, and yet its potential to unify the study of stand-alone psychological trait scales has never been compellingly demonstrated. In the present research we found that sizable majority of such scales were similarly closely related to the Big Five as multiple facets of the Big Five—and indeed might reasonably be treated as facets themselves—suggesting that the Big Five can indeed fulfill its promise as an organizing framework of personality traits, for both trait-descriptive words and established stand-alone trait scales. Were this promise to be fulfilled, many stand-alone scales may continue to complement the Big Five, but authors would acknowledge scales’ locations within Big Five space and integrate their research with prior pertinent Big Five findings. As a consequence, scales with reliability, validity, or Jangle Fallacy concerns would be more easily identified and either remedied or replaced. Research would accordingly become less susceptible to isolation within silos, redundant research would be reduced, and psychological research findings would be more readily integrated and accumulated.

Appendix: R packages

R packages that were in the process of preparing this manuscript that were not listed in the Statistical Software and Packages section of Study 1 are listed here. CFA and bi-factor measurement models were conducted using lavaan (Rosseel et al., 2021); omega reliability was estimated with BifactorIndicesCalculator (Dueber, 2021); proportion confidence intervals were estimated with binom (Dorai-Raj, 2014); and various additional analyses were conducted with the aid of psych (William Revelle, 2021) and GPArotation (Bernaards & Jennrich, 2014). Packages used to create the manuscript, tables, and figures, include: bookdown (Xie, 2021a); ggplot2 (Wickham et al., 2020); kableExtra (Zhu, 2021); knitr (Xie, 2021b); papaja (Aust & Barth, 2021); and rmarkdown (Allaire et al., 2021). Packages used during data cleaning, analysis, and other data manipulation processes include: data.table (Dowle & Srinivasan, 2021); lubridate (Spinu et al., 2021); openssl (Ooms, 2021); prettyR (Lemon & Grosjean, 2019); readr (Wickham & Hester, 2020); reshape2 (Wickham, 2020); and spatstat (Baddeley et al., 2021).

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