

A multi-faceted, open source, measure of personality

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## Abstract

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## 1. Introduction

Over the last decades, the Five Factor Model as well as the Big Five model have become widely accepted models for describing general attributes of personality. Often the terms are even used synonymously, which is why we will refer to the Big Five from here on. The Big Five is a hierarchical model which describes human individual differences in personality at the dispositional level: one of the most basic, universal, biologically-influenced and stable layers of human inter-individual differences in behavior, cognition and feeling (McAdams & Pals, 2006). Its hierarchical conception is relevant to acknowledge behavior from the most specific (nuances), to the most broad differences in temperament and character (dimensions), through a varying number of mid-level personality characteristics called facets. Most of the research concerning criterion validity of the Big Five inventories has focused on the covariation between the Big Five dimensions and relevant external outcomes. However, specific dispositional characteristics captured on the facet level might be of extreme utility to provide more complex descriptions of individuality and to predict life outcomes to a major extent (Lounsbury, Sundstrom, Loveland, & Gibson, 2002; Paunonen & Ashton, 2001; Ziegler et al., 2014). Unfortunately, the number and nature of the facets below the Big Five and being measured by different personality instruments is far from being consensual. In fact, different facet level models have been proposed (XXXX). One potential reason for this could be that many facet level models were developed after a questionnaire version without such a level had been published. Thus, the facets were developed as an elaboration. While this has many theoretical advantages it also has the disadvantage of potentially limiting the search space of possible facets. In this work we aim at maximizing this search space and present a personality questionnaire which is broad at the facet level, open-access, and measurement invariant across two different cultures.

## 1.2. A short history of the Big Five

Francis Galton proposed the fundamental lexical hypothesis as a ground from where to describe interpersonal differences in personality. The hypothesis states that every apprehended characteristic in the realm of personality should have its place in the natural language, a corollary derived from this first statement is that the essential features must represent a unique word in the lexical universe of this language. Galton (1884) himself, and later Allport and Odbert (1936) and still later Norman (1967) used English dictionaries for a systematic collection of all adjectives which could be related to human personality characteristics. Using exploratory factor analyses on self- and other ratings five broad factors could repeatedly be extracted from the data. These efforts were also replicated in different languages, such as in German (Klages,...), Baumgartner,...

Cattell was one of the first researchers who systematically applied exploratory factor analysis in order to explore personality structure. He inspected the correlation structure of the items in the word lists of his predecessors, finding 16 personality oblique factors, including one factor specifically for intelligence, these factors form the 16-PF. These 16 factors were the primary factors in a hierarchical structure for Cattell (coetany to L.L. Thurstone and undoubtedly influenced by him). Cattell himself viewed personality as a hierarchical structure, containing three layers (Cattell, 1956). The second order factors resemble the Big Five dimensions (Digman, 1990).

Different researchers followed Cattell in the study of dispositional traits of personality. One of the most influential models was Eysenck's Big Three. Grounded on a strong biological basis, Eysenck's theory supposed a link between temperament and personality. Its structural proposal concerned at first two big factors, named Neuroticism vs. Emotional stability and Extraversion vs. Introversion. These two dimensions were later joined by a third factor that Eysenck called Psychoticism. This label was criticized by others who suggested

that a more appropriate term would be psychopathy (Digman, 1990). Eysenck's big two are still „alive“ today in the Big Five, and his third factor, psychoticism, can be operationalized as two dimensions of the Big Five: Agreeableness (or ...) and Conscientiousness (or ...).

A large number of studies have focused on the problem of personality structure resulting in a five factor solution (Borgatta, 1964; Fiske, 1949; Norman, 1967; Tupes & Christal, 1961). Possibly the two most widely cited works relating to the foundations of the Big Five are those by Goldberg et al. (2006) and Costa and McCrae (1995). Goldberg can be seen as one of the first who extended research concerning the Big Five, while McCrae and Costa's importance rests on popularizing the terminology (OCEAN) and the development of one of the most used tools to assess personality based on the Big Five: the NEO-PI. The Big Five dimensions are labeled as follows: I) Extraversion vs. Introversion. II) Agreeableness or Friendliness. III) Conscientiousness or Achievement or Will. IV) Emotional Stability vs. Neuroticism, and V) Openness or Intellect or Culture.

One of the most important features of the Big Five is the fact that it could be replicated in different languages. Research is available in Japanese, Vietnamese, German, Spanish, Greek, (refs)... This finding suggests that the way human beings construe personality is at some point universal and that its basic features are retained within the Big Five. Another essential characteristic relies on its hierarchical nature. The five domains are useful to retain the big picture of personality, maximize the situation consistency and reliably assess difficult subjects such as children. Nonetheless, each dimension is conceptualized as a latent construct formed by more specific narrow factors called facets, which in turn are useful to depict the impact of personality characteristics into specific behaviors and concrete life outcomes.

The Big Five has proven to be a valid theoretical and empirical model to predict relevant life outcomes. Research such as Ozer and Benet-Martínez (2006) or Roberts, Kuncel, Shiner, Caspi, and Goldberg (2007) has shown that scores for the Big Five dimensions (and

their related facets) are able to explain outcomes such as academic and work performance, health, personality disorders, political attitudes and many more. The empirical findings linking Big Five measures to life outcomes have reinforced the concurrent validity of the test scores interpretations. At the same time, the broad nature of the domains has spurred research into the more fine-grained lower order structure of facets.

### 1.3. Facet Structures

There are a number of models that include a facet structure below the five broad domains. The most widely known model is the one suggested by Costa and McCrae (1995). Other popular models have been suggested for the Big Five Inventory 2 (BFI-2; Soto & John, 2016), the IPIP (Goldberg et al., 2006), and the HEXACO model (Lee & Ashton, 2016), which assumes six broad domains. Table 1 gives an overview of these different models listing their facets per domain as well as some information regarding their psychometric properties.

< Table 1 >

As shown in table 1, there are many different possibilities of facets forming the domains. However, there is still a degree of overlap on the facets covered by the different instruments. Soto and John (2009) inspected the convergences between the NEO-PI-R and the first version of the BFI, suggesting that two constructs per domain were measured at the facet level by both inventories. The constructs defined by Soto and John (2009) were: Assertiveness and Activity for Extraversion; Altruism and Compliance for Agreeableness; Order and Self-Discipline for Conscientiousness; Anxiety and Depression for Neuroticism; and Aesthetics and Ideas for Openness. The convergence holds for the four instruments listed in table 1, as these ten constructs are covered within the facets for every instrument. Some of the constructs are explicitly covered at the facet level (e.g. Anxiety); meanwhile

others are mainly covered though the four instruments, although sometimes implicitly (e.g. Liveliness in HEXACO resembles the “core” construct Activity, present in all other instruments). The reverse is not always true, not every facet within the four instruments is covered by the constructs proposed by Soto and John (2009). As an example we find Self-Consciousness, a Neuroticism facet defined by the NEO-PI-R and the IPIP-NEO-120, which is clearly tapping at a construct different from Anxiety or Depression.

The nomological network commonly assumed in Big Five questionnaires is drawn from nuances through facets to domains, from more specific to more general. Relying in domains to explain and predict behavior can benefit from ease of interpretability. However, optimal predictions for specific contexts can be enhanced if a more specific set of traits is used. On the other hand, using nuances to predict behavior might yield even stronger predictive ability (Seeboth & Möttus, 2018), but as the number of predictors grows the interpretations become more complex. Facets are on a middle ground between nuances and domains, in a compromise between specificity and sensitivity in the bandwidth-fidelity dilemma. This narrow aggregation both satisfies the specificity of predictions to concrete situations and environments and also enhances the ease of interpretability when summarizing individual personality characteristics.

Furthermore, there is a large corpus of research which points towards facets as important criterion predictors showing incremental validity to domains. For academic achievement, Paunonen and Ashton (2001) showed that the facets achievement motivation and intellectual curiosity increased the variance accounted for by college students’ grades, above and beyond its respective dimensions: Conscientiousness and Openness to experience. Similarly, Lounsbury et al. (2002) provided evidence regarding the facets work drive and aggression, which added an extra 12% of explained variance over the Big Five domains on 10th grade students’ GPA. Ziegler, Danay, Schölmerich, and Bühner (2010) showed that better performance in college grades was associated with low gregariousness, excitement

seeking and order as well as high activity, openness to ideas and openness to values. Often different facets within the same domain can have effects in opposite directions, partially canceling out the predictive ability when only paying attention to the domain score. This is the case for Openness to ideas vs. Openness to fantasy, as the former is related positively to academic achievement whereas the latter is related negatively (Ziegler et al., 2014), resulting in a potential masking effect on the ability of Openness predicting the academic achievement.

As described above, facet measures often yield scores that have stronger test-criterion correlations than their respective domain scores (e.g., Ziegler et al., 2012; ...). However, facet scores have also been shown to be related to personality disorders. Thus, the combination of a higher fidelity along with the potential clinical relevance of facet scores might open up unique advantages for clinical research.

#### 1.4. The Big Five and Personality Disorders

Personality disorders are steadily shifting from a categorical definition into a continuous conceptualization within the clinical realm. This process is not new for personality science history, as the subject itself moved from a qualitatively distinct set of definitions, called types, into a subset of continuous domains in which both normality and extreme tendencies were moving along, named traits. In fact, the new version of the Diagnostic and Statistical Manual of mental disorders, DSM- V, now proposes two different ways of assessing personality disorders: 1) A descriptive model of personality disorders in section II which mimics the former model of assessing personality disorders and; 2) A novel trait model that follows research on the personality scientific domain (In section III), which conceptualizes personality disorders as extreme tendencies located in the continuum of the Big Five domains and facets (American Psychiatric Association, 2013; Widiger & Mullins-Sweatt, 2009)

This paradigm shift in clinical assessment of personality has led to the construction of



the Personality Disorder Inventory (PID-5; Krueger, Derringer, Markon, Watson, & Skodol, 2012), a 25-facet and five-dimension self-report inventory, with an informant-report version (Markon, Quilty, Bagby, & Krueger, 2013). The big five dimensions mirror the Big Five domains, although with a focus on the maladaptative end of the continuum,: I) Detachment (Big Five's Introversion), II) Antagonism (absence of Big Five's Agreeableness), III) Disinhibition (absence of Big Five's Conscientiousness), IV) Negative affect (Big Five's Neuroticism) and V) Psychoticism (Absence of Big Five's Openness). The PID-5 has shown satisfying evidences of criterion validity (...summary). However, the limited number of facets on the PID-5 has already raised some concerns due to the low reliability when studying developmental phenomena of personality disorders (???), and may also limit the capacity of portraying vivid personality profiles which are suitable for explanatory purposes in the clinical domain.

In line with what has been stated previously for academic achievement, the examination of facets may result in an enhancement of the specificity of assessment when looking at the nature of PDs (Clark, 2005; Samuel & Widiger, 2008). This improvement of specificity resulted in a predictive gain ranging from 3% to 16% when comparing facets to domains predicting PD in the Reynolds and Clark (2001) study. Furthermore, the use of facets may be of extreme utility for those PD whose personality profile is less clear at the domain level. As Saulsman and Page (2004) point out, Schizotypal and Obsessive-Compulsive disorders are examples of PD which are not well covered by Big Five domains. A reason for it may be found in a pattern inconsistency of facets within the same dimension or in a lack of coverage for essential characteristics of the PD. For example, aberrant cognitions are essential characteristics of schizotypal disorder and are not covered by some instrument's facets like the NEO-PI-R (Samuel & Widiger, 2008; Saulsman & Page, 2004). Likewise, the expected high scores on warmth and low scores on assertiveness could mask the effects of extraversion when predicting Dependent Personality Disorder, following the theoretical correspondence between PD and Big Five facets proposed by Costa Jr. and

Widiger (1994). Moreover, the PID-5 has prompted the elaboration of a number of Five Factor Model Personality Disorders (FFMPD) scales to maximize the facet coverage in relation to specific PDs (Bagby & Widiger, 2018).

Facet analysis and dedicated Big Five questionnaires have been used to solve issues like those mentioned in the last paragraph. We propose to base such research on a broader facet basis. To this end we suggest a general instrument to cover a broad number of facets which could aim for fine grained assessments.

### 1.5. This study

We present in this paper an instrument for personality assessment which aims to cover the need for an internationally usable, open source, and differentiated measure at the facet level. Two studies are presented, for each one inspects the factor structure of the instrument in a different sample drawn from a different culture (American vs. German). Measurement invariance across samples will be examined. Internal consistency and test-criterion correlations will be estimated for all scores. To sum up, the aim for this research project was to provide an instrument that can be used in non-clinical but also in clinical research which emphasizes the facet level of the Big Five.

## 2. Methods

Two different studies are presented in this work. The first study uses a sample drawn from a USA bachelor student population. The aim was to detect and confirm a measurement model that maximizes the facet space of the IPIP instrument. An Exploratory Factor Analysis (EFA) was used to identify the number of facets per domain. A Confirmatory Factor Analysis per facet was modelled in order to confirm the item - facet relationship. Finally, an Exploratory Structural Equation Model (ESEM) was fitted to

integrate the measurement model of the facets with the dimensions. ESEM is a novel method which allows the researcher to use Structural Equation Modelling (SEM) without the need of imposing an independent cluster solution, as its common in the CFA (Confirmatory Factor Analysis) procedure. ESEM has gained reputation in the personality field, where the independent cluster model may not capture the complexity of the constructs measured (Marsh et al., 2010).

The second sample was drawn again from a graduate student population, albeit this time based in Germany. The aim for the second study is to replicate the structure found in study one, plus assess the degree of measurement invariance of the proposed model.

## 2. Study 1 - US-American Sample

**2.1.1. Participants.** The sample consisted of 722 American undergraduate students (59.30% male) who participated voluntarily. The mean age was 21.60 years ( $SD = 5.90$ ). Students were emailed a link to a computerized assessment battery that included the IPIP items as well as several other tests not reported in this paper. The data set was randomly splitted in two equally sized samples. Both samples were matched in relation to missing values, outliers and extreme values. In Sample 1 the mean age was 21.80 years ( $SD = 6.30$ ), in Sample 2 the mean age was 21.50 years ( $SD = 5.60$ ).

### 2.1.2. Measures.

**International Personality Item Pool (IPIP).** Altogether, 525 items from the *International Personality Item Pool* (IPIP) were used to measure Neuroticism, Extraversion, Openness (to experience), Agreeableness and Conscientiousness. The IPIP is an open source database of personality items, which was launched in 1996, and contains over 2000 items (Goldberg et al., 2006). Participants were asked to rate themselves on typical behaviors or

reactions on a 5-point Likert scale, ranging from 1 (“Not all like me”) to 5 (“Very much like me”).

**Satisfaction With Life (SWL).** Measured with a 5 item composite defined in Diener, Emmons, Larsen, and Griffin (1985).

**GPA.** Grade Point Averages measured in high school, university, and in cc.

**SAT.**

**ACT.**

**Absences from class.** As a behavioral measure absence from class was asked to report from subjects. ABS2 ABS4 what are the differences?

### 2.1.3. Procedure

**EFA with subsample 1.** To determine the number of possible facets per domain Velicer (1976) Minimum Average Partial (MAP) method and Horn (1965) parallel analysis (PA) were employed for every domain. Based on these results an Exploratory Factor Analysis (EFA) was calculated for each domain via Mplus using a geomin rotation (Quelle) and a Maximum Likelihood estimator (ML). The decision for the preferred number of facets per domain was based partly on comparing model fits (CFI, RMSEA, SRMR). More importantly though was the interpretability of the facet solution. Facet solutions of other personality measures were inspected and compared to the found facet structure. If there were important parts missing to present the domain with regards to content, new facets would be added a posteriori.

**CFA and ESEM with subsample 2.** To confirm the structure of facets the EFAs delivered, multiple CFAs were calculated via Mplus. In a first step, measurement models

were estimated for each of the facets. To obtain balance between the facets, the items were reduced to five per facet based on item content and loading pattern. In a second step, the estimations for the measurement models on facet levels were repeated via CFA. For both steps estimators were WLSMV (Weighted Least Squares adjusted for Means and Variances). Aim was to ensure an optimal breadth and sufficient reliability. In a final model, all five domain structural models were integrated using Exploratory Structural Equation Modeling (ESEM; Asparouhov & Muthén, 2009). Marsh et al. (2010) could show that ESEM fits personality data better and results in substantially more differentiated factors than it would using CFA, while using an EFA measurement model with rotations in a structural equation model. All facets were able to load on all domains. If there would show up facets that do not significantly load on the intended domain, this facets would get eliminated subsequently. The estimators used were ML, factor scores were used as indicators and the rotation was oblique (using Geomin). Model fit was determined based on the guide lines by Hu and Bentler (1999) as well as Beauducel and Wittmann (2005). Consequently, to consider a good fit of a proposed model, the Comparative Fit Index (CFI) should be at or over .95, the Standardized Root Mean Squared Residual (SRMR) smaller than .08 and the Root Mean Square Error of Approximation (RMSEA) smaller than .06.

**Criterion validity evidence.** To examine the nomological structure of the facets and domains to external constructs, correlations at the facet level were computed.

## 2.2. Results

**Results of EFA.** In *Table 2* model fits for the chosen facet model for each domain are shown, as well as Eigenvalues and results from MAP and PA test. To ensure the homogeneity of the facets and to reduce the risk of cross domain loadings, items with factor loadings less than .30 were eliminated. This was only done when item content was also judged as being non-central to the domain in question (Ziegler et al., 2014).

< Table 2 here >

According to the exploratory model, Agreeableness consists of eight facets after two facets were eliminated due to weakly loading and inconsistent items. The remaining facets are named Appreciation, Integrity, Low Competitiveness, Readiness to Give Feedback, Search for Support, Good Faith, Genuineness and Altruism.

Conscientiousness consists of nine facets after one facet with item factor loadings less than .30 was excluded, they are: Dominance, Persistence, Self-discipline, Task planning, Goal orientation, Carefulness, Orderliness, Wish to work to capacity and Productivity.

Extraversion is formed by nine facets. A new facet (Energy) was added in order to tap better the physical component of Extraversion, which was missing in the eight facet solution. The facets are Sociability, Readiness to take risks, Wish for affiliation, Positive attitude, Forcefulness, Communicativeness, Humor, Conviviality and Energy.

Neuroticism (interpreted here as emotional stability) consists of seven facets. One facet was dropped due to poor interpretability, and was therefore not included in the subsequent analyses. The final set of facets are named Equanimity, Confidence, Carefreeness, Mental balance, Drive, Emotional robustness and Self-attention.

Openness to experience comprises of nine facets. One facet was identified as a method factor and eliminated, because it solely contained negatively formulated items and no coherent underlying trait could be identified. Furthermore another facet (Intellect) was added, because the remaining facets lacked an intellectual content. The facets of Openness are named Creativity, Wish for variety, Open-mindedness, Interest in reading, Artistic interests, Wish to analyze, Willingness to learn, Sensitivity and Intellect.

The items to each facet are listed in the appendix (A).

**Results of CFA and ESEM.** All measurement models for the facets were fitting well, results can be found in *Table 3*. In this table both five-item facets and multiple-item facets are presented with their respective model fit measures. The 5-item facets normally outperform the multiple-item facet versions regarding model fit.

< Table 3 here caption="Model fit for each facet">

The ESEM of the final model with all five domains fits approximately with CFI = .87, RMSEA = .072, SRMR = .036. As you can see in *Table 4* nearly all facets load significantly on their intended domain. Some cross loadings can be found as they are plausible with ESEM procedures. However, in any case the number of cross loadings is high or inconsistent with the facet content.

< Table 4 here caption="ESEM factor scores">

**Criterion validity evidence.** Bivariate correlations of the facets with the external criteria are shown in *table 5*. The facets N2 (Confidence,  $r = 0.53$ ) and E4 (Positive attitude,  $r = 0.49$ ) show the highest correlations with SWL respectively. The SWL scale was also correlated with facets such as N4 (Mental balance,  $r = 0.25$ ) and N5 (Drive,  $r = 0.27$ ) in the Neuroticism / Emotional stability realm. C5 (Goal orientation,  $r = 0.28$ ) and C2 (Persistence,  $r = 0.27$ ) in Conscientiousness. E1 (Sociability,  $r = 0.26$ ) and E9 (Energy,  $r = 0.25$ ) in the Extraversion domain. O9 (Intellect,  $r = 0.24$ ) and O3 (Open-mindedness,  $r = 0.22$ ) in Openness and A6 (Good faith,  $r = 0.25$ ) in the Agreeableness domain.

Regarding the academic performance criteria (GPA, SAT and ACT), the Openness facets O4 (Interest in reading), O6 (Wish to analyze) and O9 (Intellect) yield the most consistent correlations. Interestingly, O4 correlates directly with the reading subtests of SAT

( $r = 0.25$ ) and ACT ( $r = 0.2$ ) and shows a negligible relationship with the math ( $r = 0.06$  /  $0.08$ ) subscales, providing evidences for discriminant validity (maybe this for the discussion).

Furthermore, the global GPA scale (assuming cc is for global) correlated with several Conscientiousness and Agreeableness facets. C9 (Productivity,  $r = 0.4$ ), C5 (Goal orientation,  $r = 0.38$ ) and C4 (Task planning,  $r = 0.35$ ) yield the higher correlations with overall GPA respectively in the Conscientiousness domain, and A1 (Appreciation,  $r = 0.32$ ) in the Agreeableness domain.

Concerning the behavioral criteria controlled in this study, absence from class, the meaningful correlations unsurprisingly loaded within the facets at the Conscientiousness domain. Particularly the facets C4 (Task planning,  $r = -0.22$  /  $-0.26$ ), C7 (C6: Carefulness,  $r = -0.21$  /  $-0.21$ ) and C9 (Productivity,  $r = -0.21$  /  $-0.24$ ) were the most robust indicators of this criteria.

< Table 5 here caption="Criterion correlations" >

## Study 2 – German Sample

**Participants.** The representative sample consisted of 387 German speakers (49.10% male) with a mean age of 45.60 years ( $SD = 17.50$ ). (How was the data collected?)

**Measures.** The five items per facet derived from Study 1 were translated and back-translated by bilingual experts, creating a German version of the measure used there. The translated items can be found on appendix B.

## Procedure



**Step 1 – Examining the structure.** To check the facet structure Study 1 delivered, multiple confirmatory factor analyses were calculated via Mplus following an analogue procedure to Study 1. First, measurement models were estimated for all facets, using WLSMV as the estimator. Model fit was determined based on the guide lines mentioned above. In a final model, all five domain structural models were integrated using ESEM.

**Step 2 – Testing for measurement invariance.** In a next step, measurement invariance between German and US samples was examined. We followed the procedure suggested by Sass (2011) and tested configural, factorial and strong factorial invariance. The cutoffs suggested by Chen (2007) were applied to compare model fits. According to this configural measurement invariance can be assumed when the same item is associated with the same factor in each domain, while the factor loadings can differ. If the factor loadings of each item would not differ between the samples, factorial measurement invariance can be assumed. Strong factorial measurement invariance can be assumed when on top of that the intercepts of each item are equal. The limit to factorial measurement invariance was set to  $\Delta$  CFI  $< .01$ ,  $\Delta$  RMSEA  $< .015$  and  $\Delta$  SRMR  $< .03$ , at which the limit to strong factorial measurement invariance was set to  $\Delta$  CFI  $< .01$ ,  $\Delta$  RMSEA  $< .015$ ,  $\Delta$  SRMR  $< .01$  (Chen, 2007).

## Results

**Results of CFA.** The measurement models of the American sample were replicated for the reduced number of items per facet. Model fits can also be seen in *Table 3*. The ESEM with all five domains show an approximate fit to the data with CFI = .82, RMSEA = .078, SRMR = .044. *Table 6* shows the ESEM factor loadings for the German sample. All facets load significantly on their intended domain but can have loadings on other domains as well.

<Table 6 here >

**Results of MI.** For analyzing the measurement invariance the latest facet model structure (with additional facets) was taken. The results are shown in Table 7. Configural measurement invariance is assumed for the facets Appreciation of others, Superiority/Grandiosity, Need to be liked, Crybabiness, Manipulation, Altruism (facets of Agreeableness), Perseverance, Task Planning, Goal-orientation/Achievement striving, Preferred Load, Procrastination (facets of Conscientiousness), Assertiveness, Sociability/Gregariousness, Activity (facets of Extraversion), Irritability, Self-serving Attention (facets of Neuroticism), Self-attributed Ingenuity, Openness to actions and activities, Openmindedness/Judgement, Love of Learning, Openness to feelings and Intellect (facets of Openness).

Factorial measurement invariance is assumed for the facets Meanness, Trust (facets of Agreeableness), Control of others, Lack of (Self-) Control, Deliberation/Caution, Lack of Tidiness/Order (facets of Conscientiousness), Sensation Seeking, Reclusiveness, Emotionality, Humor (facets of Extraversion), Depression, Anxiety, Self-assuredness, Lethargia, Sentimentality (facets of Neuroticism), Openness to reading, Openness to arts and Need for cognition (facets of Openness).

The only facet with strong factorial measurement invariance is Shyness, a facet of Extraversion

<Table 7 here>

## Discussion

We have presented in this work an open-access instrument for personality assessment within the Big Five framework, which showed evidences of factorial validity in two different cultures and maximized the space set of facets encompassed. In addition, evidences for external criteria validity were attained.

The instrument covers all the “core” facets proposed by Soto and John (2009), either directly or indirectly. The Energy construct in Extraversion is literally covered by a three-item facet in our instrument, whereas the Assertiveness construct has been tapped by items belonging to the Wish for affiliation, Communicativeness and Conviviality facets. Altruism is directly reflected in a five-item facet, while the Compliance construct is reflected by our Good faith facet. The Order and Self-discipline constructs proposed by Soto and John (2009) are mirrored by dedicated facets in our instrument. The Anxiety and Depression constructs are mirrored by the facets Mental balance and Emotional robustness, respectively. For the Openness dimension, the Aesthetic construct is covered by our facet Artistic interest, while the Ideas construct has been reflected by both the Open-mindedness and the Wish to analyze facets.

The instrument also covers all facets proposed by the most influential Big Five measures as seen in *Table 1*, although with a few exceptions. For example the Patience facet proposed in the HEXACO model for the Agreeableness domain is not covered in our instrument. Nonetheless, Patience can be understood as forming the Self-discipline domain, specially with items such as “I rush into things” (See appendix A). In fact, Self-discipline has important cross-loadings with Agreeableness in both samples ( $\lambda = .256$  in the USA sample and  $\lambda = .341$  in the german sample).

In addition we included even more facets.

418       The evidences for reliability and structural validity are retained. Like most of the Big  
419 Five instruments, ours could not survive to the CFA independent cluster model. Even  
420 though ESEM has been used to provide structural validity evidence of personality measures  
421 recently. Here we show that the standards for a good ESEM model are met. Furthermore  
422 the structural validity is robust between two different cultures.

423       We have collected some criterion validity evidences. Like bla bla bla. Nonetheless the  
424 multi - facettet nature of the instrument makes forthcoming evidences for criterion and  
425 predictive validity promising.

426       One limitation is the sample used. Students are not a representative population of  
427 society and results may not be generalized.

428       Future directions are to provide a tool with the subset of items for public use. Gather  
429 community sample, from more cultures and test the extent of the universality of the  
430 instrument. And use the instrument to predict important life outcomes so the links between  
431 specific behaviors and facets become richer.

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Brick and Lewis (2014); Gaughan, Miller, and Lynam (2012); Leone, Chirumbolo, and Desimoni (2012); McCabe, Oswald, and Connelly (2014); Gaughan, Miller, Pryor, and Lynam (2009); Nofle and Shaver (2006); Bagby, Taylor, and Parker (1994); Schimmack, Furr, and Funder (1999); Wakabayashi, Baron-Cohen, and Wheelwright (2006); Shaver and Brennan (1992); Ruiz, Pincus, and Dickinson (2003); McCrae, Kurtz, Yamagata, and Terracciano (2011); Rosander, Bäckström, and Stenberg (2011); McAdams and Donnellan (2009); Siddiqui (2011); Hagger-Johnson and Whiteman (2007)

## References

- Allport, G. W., & Odbert, H. S. (1936). Trait-names: A psycho-lexical study. *Psychological Monographs*, 47(1), i–171. doi:10.1037/h0093360
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (5th ed.)*.
- Asparouhov, T., & Muthén, B. (2009). *Exploratory structural equation modeling* (Vol. 16, pp. 397–438). doi:10.1080/10705510903008204
- Bagby, R. M., Taylor, G. J., & Parker, J. D. (1994). The twenty-item Toronto Alexithymia scale-II. Convergent, discriminant, and concurrent validity. *Journal of Psychosomatic Research*, 38(1), 33–40. doi:10.1016/0022-3999(94)90006-X
- Bagby, R. M., & Widiger, T. A. (2018). Five factor model personality disorder scales: An introduction to a special section on assessment of maladaptive variants of the five factor model. *Psychological Assessment*, 30(1), 1–9. doi:10.1037/pas0000523
- Beauducel, A., & Wittmann, W. (2005). Simulation study on fit indices in confirmatory factor analyses based on data with slightly distorted simple structure. *Structural Equation Modeling*, 12, 41–75. doi:10.1207/s15328007sem1201
- Borgatta, E. (1964). The structure of personality characteristics. *Behavioral Science*, 9(1), 8–17. doi:10.1007/BF01358190
- Brick, C., & Lewis, G. J. (2014). Unearthing the “Green” Personality: Core Traits Predict Environmentally Friendly Behavior. *Environment and Behavior*, 48(5), 635–658. doi:10.1177/0013916514554695
- Cattell, R. B. (1956). Second-order personality factors in the questionnaire realm. *Journal*

of *Consulting Psychology*, 20(6), 411–418. doi:10.1037/h0047239

Chen, F. F. (2007). Sensitivity of goodness of fit indexes to lack of measurement invariance.

*Structural Equation Modeling*, 14(3), 464–504. doi:10.1080/10705510701301834

Clark, L. A. (2005). Temperament as a unifying basis for personality and psychopathology.

*Journal of Abnormal Psychology*, 114(4), 505–521. doi:10.1037/0021-843X.114.4.505

Costa, P. T., & McCrae, R. R. (1995). Domains and facets: hierarchical personality

assessment using the revised NEO personality inventory. *Journal of Personality*

*Assessment*, 64(1), 21–50. doi:10.1207/s15327752jpa6401\_2

Costa Jr., P. T., & Widiger, T. A. (1994). A description of the DSM-III-R and DSM-IV

personality disorders with the five-factor model of personality. *Personality Disorders*

*and the Five-Factor Model of Personality*, (January), 41–56. doi:10.1037/10140-003

Diener, E., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The Satisfaction With Life

Scale. *Journal of Personality*, 49(1), 71–75. doi:10.1207/s15327752jpa4901

Digman, J. M. (1990). Personality Structure: Emergence of the Five-Factor Model. *Annual*

*Review of Psychology*, 41(1), 417–440. doi:10.1146/annurev.ps.41.020190.002221

Fiske, D. W. (1949). Consistency of the factorial structures of personality ratings from

different sources. *Journal of Abnormal and Social Psychology*, 44(3), 329–344.

doi:10.1037/h0057198

Galton, F. (1884). The Measurement of Character. doi:10.1037/11352-058

Gaughan, E. T., Miller, J. D., & Lynam, D. R. (2012). Examining the Utility of General

Models of Personality in the Study of Psychopathy: A Comparison of the

HEXACO-PI-R and NEO PI-R. *Journal of Personality Disorders*, 26(4), 513–523.

doi:10.1521/pedi.2012.26.4.513

- Gaughan, E. T., Miller, J. D., Pryor, L. R., & Lynam, D. R. (2009). Comparing two alternative measures of general personality in the assessment of psychopathy: A test of the NEO PI-R and the MPQ. *Journal of Personality*, 77(4), 965–995. doi:10.1111/j.1467-6494.2009.00571.x
- Goldberg, L. R., Johnson, J. A., Eber, H. W., Hogan, R., Ashton, M. C., Cloninger, C. R., & Gough, H. G. (2006). The international personality item pool and the future of public-domain personality measures. *Journal of Research in Personality*, 40(1), 84–96. doi:10.1016/j.jrp.2005.08.007
- Hagger-Johnson, G. E., & Whiteman, M. C. (2007). Conscientiousness facets and health behaviors: A latent variable modeling approach. *Personality and Individual Differences*, 43(5), 1235–1245. doi:10.1016/j.paid.2007.03.014
- Horn, J. L. (1965). A rationale and test for the number of factors in factor analysis. *Psychometrika*, 30(2), 179–185. doi:10.1007/BF02289447
- Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, 6(1), 1–55. doi:10.1080/10705519909540118
- Krueger, R. F., Derringer, J., Markon, K. E., Watson, D., & Skodol, A. E. (2012). Initial construction of a maladaptive personality trait model and inventory for DSM-5. Initial construction of a maladaptive personality trait model and inventory for DSM-5. *Psychological Medicine*, 42(09), 1872–1890. doi:10.1017/S0033291711002674
- Lee, K., & Ashton, M. C. (2016). Psychometric Properties of the HEXACO-100. *Assessment*, 1-15. doi:10.1177/1073191116659134
- Leone, L., Chirumbolo, A., & Desimoni, M. (2012). The impact of the HEXACO personality model in predicting socio-political attitudes: The moderating role of interest in



509 politics. *Personality and Individual Differences*, 52(3), 416–421.

510 doi:10.1016/j.paid.2011.10.049

511 Lounsbury, J. W., Sundstrom, E., Loveland, J. L., & Gibson, L. W. (2002). Broad versus  
512 narrow personality traits in predicting academic performance of adolescents. *Learning  
513 and Individual Differences*, 14(1), 67–77. doi:10.1016/j.lindif.2003.08.001

514 Markon, K. E., Quilty, L. C., Bagby, R. M., & Krueger, R. F. (2013). The Development and  
515 Psychometric Properties of an Informant-Report Form of the Personality Inventory  
516 for DSM-5 (PID-5). *Assessment*, 20(3), 370–383. doi:10.1177/1073191113486513

517 Marsh, H. W., Lüdtke, O., Muthén, B., Asparouhov, T., Morin, A. J., Trautwein, U., &  
518 Nagengast, B. (2010). A New Look at the Big Five Factor Structure Through  
519 Exploratory Structural Equation Modeling. *Psychological Assessment*, 22(3), 471–491.  
520 doi:10.1037/a0019227

521 Mcabee, S. T., Oswald, F. L., & Connelly, B. S. (2014). Bifactor Models of Personality and  
522 College Student Performance: A Broad Versus Narrow View. *European Journal of  
523 Personality*, 28(6), 604–619. doi:10.1002/per.1975

524 McAdams, D. P., & Pals, J. L. (2006). A new Big Five: Fundamental principles for an  
525 integrative science of personality. *American Psychologist*, 61(3), 204–217.  
526 doi:10.1037/0003-066X.61.3.204

527 McAdams, K. K., & Donnellan, M. B. (2009). Facets of personality and drinking in first-year  
528 college students. *Personality and Individual Differences*, 46(2), 207–212.  
529 doi:10.1016/j.paid.2008.09.028

530 Mccrae, R. R., Kurtz, J. E., Yamagata, S., & Terracciano, A. (2011). Internal consistency,  
531 retest reliability and their implications for personality Scale Validity. *Personality and  
532 Social Psychological Bulletin*, 15(1), 28–50. doi:10.1177/1088868310366253.Internal

- 533 Nofhle, E. E., & Shaver, P. R. (2006). Attachment dimensions and the big five personality  
534 traits: Associations and comparative ability to predict relationship quality. *Journal*  
535 *of Research in Personality*, 40(2), 179–208. doi:10.1016/j.jrp.2004.11.003
- 536 Norman, W. T. (1967). 2800 Personality Trait Descriptors - Normative Operating  
537 Characteristics for a University Population, 1–279.
- 538 Ozer, D. J., & Benet-Martínez, V. (2006). Personality and the Prediction of Consequential  
539 Outcomes. *Annual Review of Psychology*, 57(1), 401–421.  
540 doi:10.1146/annurev.psych.57.102904.190127
- 541 Paunonen, S. V., & Ashton, M. C. (2001). Big Five Predictors of Academic Achievement.  
542 *Journal of Research in Personality*, 35(1), 78–90. doi:10.1006/jrpe.2000.2309
- 543 Reynolds, S. K., & Clark, L. A. (2001). Predicting dimensions of personality disorder from  
544 domains and facets of the Five-Factor Model. *Journal of Personality*, 69(2), 199–222.  
545 doi:10.1111/1467-6494.00142
- 546 Roberts, B. W., Kuncel, N. R., Shiner, R., Caspi, A., & Goldberg, L. R. (2007). The Power  
547 of Personality. *Perspectives on Psychological Science*, 2(4), 313–345.  
548 doi:10.1111/j.1745-6916.2007.00047.x
- 549 Rosander, P., Bäckström, M., & Stenberg, G. (2011). Personality traits and general  
550 intelligence as predictors of academic performance: A structural equation modelling  
551 approach. *Learning and Individual Differences*, 21(5), 590–596.  
552 doi:10.1016/j.lindif.2011.04.004
- 553 Ruiz, M. A., Pincus, A. L., & Dickinson, K. A. (2003). NEO PI-R predictors of alcohol use  
554 and alcohol-related problems. *Journal of Personality Assessment*, 81(3), 265–270.  
555 doi:10.1207/S15327752JPA8103

Samuel, D. B., & Widiger, T. A. (2008). A meta-analytic review of the relationships between the five-factor model and DSM-IV-TR personality disorders: A facet level analysis. *Clinical Psychology Review*, 28(8), 1326–1342. doi:10.1016/j.cpr.2008.07.002

Sass, D. A. (2011). Testing measurement invariance and comparing latent factor means within a confirmatory factor analysis framework. *Journal of Psychoeducational Assessment*, 29(4), 347–363. doi:10.1177/0734282911406661

Saulsman, L. M., & Page, A. C. (2004). The five-factor model and personality disorder empirical literature: A meta-analytic review. *Clinical Psychology Review*, 23(8), 1055–1085. doi:10.1016/j.cpr.2002.09.001

Schimmack, U., Furr, R. M., & Funder, D. C. (1999). Personality and Life Satisfaction : A Facet-Level Analysis, 1062–1075. doi:10.1177/0146167204264292

Seeboth, A., & Möttus, R. (2018). Successful explanations start with accurate descriptions: Questionnaire items as personality markers for more accurate prediction and mapping of life outcomes. *Journal of Personality*. doi:10.17605/OSF.IO/U65GB

Shaver, P. R., & Brennan, K. A. (1992). Attachment Styles and the "Big Five" Personality Traits: Their Connections With Each Other and With Romantic Relationship Outcomes. Society for Personality; Social Psychology.

Siddiqui, K. (2011). Personality influences Mobile Phone usage. *Interdisciplinary Journal of ...*, (1981), 554–563. Retrieved from <http://papers.ssrn.com/abstract=2468985>{\%}0Ahttp://scholar.google.com/scholar?hl=en{\&}btnC

Soto, C. J., & John, O. P. (2009). Ten facet scales for the Big Five Inventory: Convergence with NEO PI-R facets, self-peer agreement, and discriminant validity. *Journal of Research in Personality*, 43(1), 84–90. doi:10.1016/j.jrp.2008.10.002

Soto, C. J., & John, O. P. (2016). The Next Big Five Inventory ( BFI-2 ): Developing and Assessing a Hierarchical Model With 15 Facets to Enhance Bandwidth ... The Next Big Five Inventory ( BFI-2 ): Developing and Assessing a Hierarchical Model With 15 Facets to Enhance Bandwidth , *Fidelit*, 113(June), 117–143.  
doi:10.1037/pspp0000096

Tupes, E. C., & Christal, R. E. (1961). Recurrent person-ality factors based on trait rating. *Lackland Air Force Base, TX: USAF*. Retrieved from <https://ejwl.idm.oclc.org/login?url=http://search.ebscohost.com/login.aspx?direct=true\&db=sih>  
live

Velicer, W. F. (1976). Determining the number of components from the matrix of partial correlations. *Psychometrika*, 41(3).

Wakabayashi, A., Baron-Cohen, S., & Wheelwright, S. (2006). Are autistic traits an independent personality dimension? A study of the Autism-Spectrum Quotient (AQ) and the NEO-PI-R. *Personality and Individual Differences*, 41(5), 873–883.  
doi:10.1016/j.paid.2006.04.003

Widiger, T. A., & Mullins-Sweatt, S. N. (2009). Five-Factor Model of Personality Disorder: A Proposal for DSM-V. *Annual Review of Clinical Psychology*, 5(1), 197–220.  
doi:10.1146/annurev.clinpsy.032408.153542

Ziegler, M., Bensch, D., Maaß, U., Schult, V., Vogel, M., & Bühner, M. (2014). Big Five facets as predictor of job training performance: The role of specific job demands. *Learning and Individual Differences*, 29, 1–7. doi:10.1016/j.lindif.2013.10.008

Ziegler, M., Danay, E., Schölmerich, F., & Bühner, M. (2010). Predicting Academic Success with the Big 5 Rated from Different Points of View: Self-Rated, Other Rated and Faked. *European Journal of Personality*, 24(July 2010), 341–355. doi:10.1002/per

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**Table captions**