A multi-faceted, open source, measure of personality

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12 Abstract

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### 17 Introduction

## Short history and relevance of the Big 5

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Over the last decades, the Five Factor Model (FFM) has become a widely accepted 19 model for describing general attributes of personality. The FFM is a hierarchical model which describes human individual differences in personality at the dispositional level: one of 21 the most basic, universal, biologically-influenced and stable layers of human inter-individual differences in behavior, cognition and feeling (McAdams & Pals, 2006). Its hierarchical 23 nature is relevant to acknowledge behavior from the most specific (nuances), to the most broad differences in temperament and character (dimensions), through an undefined number 25 of mid-level personality characteristics called facets. Most of research concerning criterion validity of the FFM inventories has focused on the covariation between the Big Five 27 dimensions and relevant external outcomes. However, specific dispositional characteristics captured in the facet level might be of extreme utility to provide more complex descriptions 29 of individuality and to predict life outcomes to a major extent (Lounsbury, Sundstrom, Loveland, & Gibson, 2002; Paunonen & Ashton, 2001; Ziegler et al., 2014). Moreover, the 31 number and nature of the facets measured by personality instruments is far from consensus, and most questionnaires cover only a few of possible facets. One of the reasons for this multiplicity of proposals is the elusiveness of the facet structure when studied in different cultures (and in different developmental periods?) (ref). In this work we present a personality questionnaire which is broad at the facet level, of open-access, and with a validated facet structure between two different cultures.

# $^{38}$ A short history of the FFM / 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

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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 himself (Galton,
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   1884), and later Allport and Odbert (1936) and still later Norman (1967) used English
   dictionaries for a systematic description of all adjectives which could be related to human
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   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
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   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,
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   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.
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   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
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   still "alive" today in the FFM, and his third factor, psychoticism, can be operationalized as
   two dimensions of the FFM: Agreeableness (or ...) and Conscientiousness (or ...). [//]:
   (find Eysenck works to cite here. also later to differentiate between trait and habit)
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A large number of studies have focused on the problem of personality structure

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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 FFM are those of Goldberg (...) and McRae Costa (...). Goldberg can be seen as one of the first who extended research concerning the FFM, while McRae & 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 FFM: the NEO-Pi. The FFM dimensions are labeled as follows: I) Extraversion vs. Introversion. II) Agreeableness or Friendliness. III)
Conscientiousness or Achievement or Will. IV) Emotional Stability vs. Neuroticism. V)
Openness or Intellect or Culture.

One of the most important features of the FFM 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 FFM. 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 FFM has proven to be a valid theoretical and empirical model to predict relevant life outcomes. Research such as (???) or (???) has shown that scores for the 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 FFM measures to life outcomes have reinforced the concurrent validity of the model.

#### 92 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 (XXX).

Other popular models have been suggested for the Big Five Inventory 2 (Soto & John, 2016),
the IPIP (JRP paper), and the HEXACO model (XXX), which also 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

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As can be seen in the table, there is no consensus at the facet level between the 100 different FFM questionnaires (look for overlaps & few words about the table?) The 101 nosological network commonly assumed in FFM questionnaires is drawn from nuances through facets to domains, from more specific to more general. Relying in domains to explain and predict behaviour can benefit from ease of interpretability. However, optimal 104 predictions for specific contexts can be enhanced if a more specific set of traits is used. On 105 the other hand, using nuances to predict behavior might yield a stronger predictive ability 106 (Seeboth & Mõttus, 2018), but as the number of predictors grow the interpretations become 107 more complex. Facets are on a middle ground between nuances and domains, in a 108 compromise between specificity and sensitivity in the bandwidth-fidelity dilemma. This 109 narrow aggregation both satisfies the specificity of predictions to concrete situations and 110 environments and also enhances the ease of interpretability when summarizing individual 111 personality characteristics. 112

Furthermore, there is a large corpus of research which points out to facets as important criterion predictors showing incremental validity to domains. For academic achievement criteria, 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 119 10th grade students' GPA. Ziegler, Danay, Schölmerich, and Bühner (2010) showed that 120 better performance in college grades were associated with low gregariousness, excitement 121 seeking and order as well as high activity, openness to ideas and openness to values. Often 122 different facets within the same domain can have effects in opposite directions, partially 123 canceling out the predictive ability of the instruments when only paying attention to the 124 dimensions. This is the case for Openness to ideas vs. Openness to fantasy, as the former is 125 related positively to academic achievement whereas the latter is related negatively (Ziegler et 126 al., 2014), resulting on a potential masking effect on the ability of Openness predicting the 127 academic achievement. 128

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.

## 132 The FFM / Big Five and Personality Disorders

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Personality disorders are steadily shifting from a categorical definition into a continua 133 conceptualization within the clinical realm. This process is not new for personality science 134 history, as the subject itself moved from a qualitatively distinct set of definitions, called 135 types, into a subset of continuous domains in which both normality and extreme tendencies 136 were moving along, named traits. In fact, the new version of the Diagnostic and Statistical 137 Manual of mental disorders, DSM-V, now proposes two different ways of assessing 138 personality disorders: 1) A descriptive model of personality disorders in section II which 139 mimics the former model of assessing personality disorders and; 2) A novel trait model that 140 follows research on the personality scientific domain (In section III), which conceptualizes 141 personality disorders as extreme tendencies located in the continuum of the FFM domains 142 and facets (???; ???) 143

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

the Personality Disorder Inventory (PID-5; (???)), a 25-facet and five-dimension self-report 145 inventory, with an informant-report version (???). The big five dimensions mirror the FFM 146 domains, although with a focus on the maladaptative end of the continuum,: I) Detachment 147 (FFM's introversion), II) Antagonism (absence of FFM's Agreeableness), III) Disinhibition 148 (absence of FFM's Conscientiousness), IV) Negative affect (FFM's Neuroticism) and V) 149 Psychoticism (Absence of FFM's Openness). The PID-5 has shown satisfying evidences of 150 criterion validity (... summary). However, the limited number of facets on the PID-5 has 151 already raised some concerns due to the low reliability when studying developmental 152 phenomena of personality disorders (???), and may also limit the capacity of portraying 153 vivid personality profiles which are suitable for explanatory purposes in the clinical domain. 154

In line with what has been stated previously for academic achievement, the 155 examination of facets may result in an enhancement of the specificity of assessment when 156 predicting PD (Clark, 2005; Samuel & Widiger, 2008). This improvement of specificity 157 resulted in a predictive gain ranging from 3% to 16% when comparing facets to domains 158 predicting PD in the Reynolds and Clark (2001) study. Furthermore, the use of facets may 159 be of extreme utility for these PD whose personality profile is less clear at the domain level. 160 As Saulsman and Page (2004) point out, Schizotypal and Obsessive-Compulsive are examples of PD which are not well covered by Big Five domains. A reason for it may be found in a 162 pattern inconsistency of facets within the same dimension or in a lack of coverage for 163 essential characteristics of the PD. For example, aberrant cognitions are essential 164 characteristics of schizotypal disorder and are not covered by some instrument's facets like 165 the NEO-PI-r (Samuel & Widiger, 2008; Saulsman & Page, 2004). Likewise, the expected 166 high scores on warmth and low scores on assertiveness could mask the effects of extraversion 167 when predicting Dependent Personality Disorder, following the theoretical correspondence 168 between PD and Big Five facets proposed by Costa Jr. and Widiger (1994). 169

Facet analysis and dedicated FFM questionnaires have been used to solve issues like those mentioned in the last paragraph. We propose in this study a general instrument to

cover a broad number of facets which could aim for fine grained assessments.

### 173 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 in this work, for each one inspects the factor structure of the instrument on a different population drawn from a different culture. Measurement invariance across populations is examined. Internal consistency and criterion validity evidence has been tested. Data has been collected in the IPIP website, and the aim for this measure is that its openly available for professionals who wish to assess personality at an extensive facet level in both English and German language.

182 Methods

## 83 Study 1 - US-American Sample

Participants. The sample consisted of 726 American undergraduate students (59.3% male), who participated voluntarily. The mean age was 21.6 years (SD=5.9). 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.

At a first data preparation the data set was randomly split 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 21.8 years (SD=6.3), in Sample 2 the mean age was 21.5 years (SD=5.6).

#### Measures.

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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 (L.

R. 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").

GPA.

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Satisfaction With Life (SWL).

Statistical analyses.

EFA with subsample 1. To determine the number of possible facets per domain 203 Velicer's (1976) Minimum Average Partial (MAP) method and Horn's (1965) parallel analysis (PA) method were employed for every domain. Based on these results an 205 exploratory factor analysis was calculated for each domain via Mplus using a geomin 206 rotation (Quelle) and a maximum likelihood estimator (ML). The decision for the preferred 207 number of facets per domain was based partly on comparing model fits (CFI, RMSEA, 208 SRMR). More importantly though was the interpretability of the facet solution. After all 209 facet solutions of other personality measures were looked at to compare it to the found facet 210 structure. If there were important parts missing to present the domain with regards to 211 content, new facets would be added afterwards. 212

CFA and ESEM with subsample 2. To confirm the structure of facets the EFAs 213 delivered, multiple confirmatory factor analyses were calculated via Mplus. In a first step 214 measurement models were estimated for each of the facets. To obtain balance between the 215 facets, the items were reduced to five per facet based on item content and loading pattern in 216 a second step, afterwards the estimations for the measurement models on facet levels were 217 repeated. 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 221 that ESEM fits personality data better and results in substantially more differentiated 222 factors than it would using CFA, while using an EFA measurement model with rotations in a 223

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 225 eliminated subsequently. The estimators used were ML (maximum likelihood), factor scores 226 were used as indicators and the rotation was oblique (using Geomin). Model fit was 227 determined based on the guide lines by Hu and Bentler (1999) as well as Beauducel and 228 Wittmann (2005). Consequently, to consider a good fit of a proposed model, the 220 Comparative Fit Index (CFI) should be at or over .95, the standardized root mean squared 230 residual (SRMR) smaller than .08 and the root mean square error of approximation 231 (RMSEA) smaller than .06. 232

Criterion validity evidence. To examine the nomological structure of the facets
and domains to external constructs like life satisfaction and education, correlations and
multiple regression were computed.

#### Results.

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Results of the EFA. In Table 1 you can see model fits for the chosen facet model
for each domain as well as Eigenvalues and results from MAP and PA test.

To ensure that each facet is homogeneous and therefore, 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, 2014).

According to that 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, which are named: Dominance, Persistence, Self-discipline, Task
planning, Goal orientation, Carefulness, Orderliness, Wish to work to capacity and
Productivity.

Extraversion comprises of nine facets, after a new facet (Energy) was added. The
original model with eight facets did not explain the physical part of Extraversion very well.
The facets are Sociability, Readiness to take risks, Wish for affiliation, Positive attitude,
Forcefulness, Communicativeness, Humor, Conviviality and Energy.

Neuroticism (here interpreted in the way of 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 2.

The exploratory structural equation model (ESEM) of the final model with all five domains fits well with CFI = .87, RMSEA = .072, SRMR = .036. As you can see in Table 3 nearly all facets load significantly on their intended domain, but sometimes have loadings on other domains also, which are conform with the theory and the facet content.

# $_{272}$ Study 2 – German Translation

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Participants. The representative sample consisted of 387 German speakers (49.1% male) with a mean age of 45.6 years (SD=17.5).

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.

Statistical analyses.

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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,

estimator was WLSMV. Model fit was determined based on the guide lines as before. In a

final model, all five domain structural models were integrated using again exploratory

structural equation modeling (ESEM).

Step 2 - Testing for measurement invariance. In a next step, measurement 284 invariance between German and US samples was examined. We followed the procedure 285 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 287 configural measurement invariance can be assumed when the same item is associated with 288 the same factor in each domain, while the factor loadings can differ. If the factor loadings of 280 each item would not differ between the samples, factorial measurement invariance can be 290 assumed. Strong factorial measurement invariance can be assumed when on top of that the 291 intercepts of each item are equal. The limit to factorial measurement invariance was set to  $\Delta$ 292 CFI < .01,  $\triangle$  RMSEA < .015 and  $\triangle$  SRMR < .03, at which the limit to strong factorial 293 measurement invariance was set to  $\Delta$  CFI < .01,  $\Delta$  RMSEA < .015,  $\Delta$  SRMR < .01 (Chen, 294 2007). 295

296 Results

297 Study 1 – Construction with an US-American sample

298 Study 2 – German Translation

Results of the CFA.. The measurement models of the American sample were replicated for the reduced number of item per facet. Model fits can be seen in Table 4. The ESEM with all five domains fits well with CFI = .82, RMSEA = .078, SRMR = .044. Table 5 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.

## 304 Study 3 – Testing for measurement invariance

For analyzing the measurement invariance the latest facet model structure (with 305 additional facets) was taken. The results are shown in Table 6. Configural measurement 306 invariance is assumed for the facets Appreciation of others, Superiority/Grandiosity, Need to 307 be liked, Crybabiness, Manipulation, Altruism (facets of Agreeableness), Perseverance, Task 308 Planning, Goal-orientation/Achievement striving, Preferred Load, Procrastination (facets of 309 Conscientiousness), Assertiveness, Sociability/Gregariousness, Activity (facets of 310 Extraversion), Irritability, Self-serving Attention (facets of Neuroticism), Self-attributed 311 Inginuity, Openness to actions and activities, Openmindedness/Judgement, Love of Learning, 312 Openness to feelings and Intellect (facets of Openness). Factorial measurement invariance is 313 assumed for the facets Meanness, Trust (facets of Agreeableness), Control of others, Lack of 314 (Self-) Control, Deliberation/Caution, Lack of Tidiness/Order (facets of Conscientiousness), 315 Sensation Seeking, Reclusiveness, Emotionality, Humor (facets of Extraversion), Depression, 316 Anxiety, Self-assuredness, Lethargia, Sentimentality (facets of Neuroticism), Openness to 317 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

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