A multi-faceted, open source, measure of personality

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12 ## Abstract

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¹⁶ A multi-faceted, open source, measure of personality

1. Introduction

¹⁸ Over the last decades, the Five Factor Model as well as the Big Five model have
¹⁹ become widely accepted models for describing general attributes of personality. Often the
²⁰ terms are even used synonymously, which is why we will refer to the Big Five from here on.
²¹ The Big Five is a hierarchical model which describes human individual differences in
²² personality at the dispositional level: one of the most basic, universal, biologically-influenced
²³ and stable layers of human inter-individual differences in behavior, cognition and feeling
²⁴ (McAdams & Pals, 2006). Its hierarchical nature is relevant to acknowledge behavior from
²⁵ the most specific (nuances), to the most broad differences in temperament and character
²⁶ (dimensions), through a varying number of mid-level personality characteristics called facets.
²⁷ Most of the research concerning criterion validity of the Big Five inventories has focused on
²⁸ the covariation between the Big Five dimensions and relevant external outcomes. However,
²⁹ specific dispositional characteristics captured on the facet level might be of extreme utility to
³⁰ provide more complex descriptions of individuality and to predict life outcomes to a major
³¹ extent (John et al., 2014; Lounsbury, Sundstrom, Loveland, & Gibson, 2002; Paunonen &
³² Ashton, 2001). Unfortunately, the number and nature of the facets below the Big Five and
³³ being measured by different personality instruments is far from being consensual. In fact,
³⁴ different facet level models have been proposed (XXXX). One potential reason for this could
³⁵ be that many facet level models were developed after a questionnaire version without such a
³⁶ level had been published. Thus, the facets were developed as an elaboration. While this has
³⁷ many theoretical advantages it also has the disadvantage of potentially limiting the search
³⁸ space of possible facets. In this work we aim at maximizing this search space and present a
³⁹ personality questionnaire which is broad at the facet level, open-access, and measurement
⁴⁰ 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

68 as two dimensions of the Big Five: Agreeableness (or . . .) and Conscientiousness (or . . . .).

69   A large number of studies have focused on the problem of personality structure

70 resulting in a five factor solution (Fiske (1949); Norman (1967); Tupes and Christal (1961);

71 Borgatta (1964)). Possibly the two most widely cited works relating to the foundations of

72 the Big Five are those by Goldberg et al. (2006) and Costa and McCrae (1995). Goldberg

73 can be seen as one of the first who extended research concerning the Big Five, while McRae

74 and Costa's importance rests on popularizing the terminology (OCEAN) and the

75 development of one of the most used tools to assess personality based on the Big Five: the

76 NEO-PI. The Big Five dimensions are labeled as follows: I) Extraversion vs. Introversion. II)

77 Agreeableness or Friendliness. III) Conscientiousness or Achievement or Will. IV) Emotional

78 Stability vs. Neuroticism. V) Openness or Intellect or Culture.

79   One of the most important features of the Big Five is the fact that it could be

80 replicated in different languages. Research is available in Japanese, Vietnamese, German,

81 Spanish, Greek, (refs). . . This finding suggests that the way human beings construe

82 personality is at some point universal and that its basic features are retained within the Big

83 Five. Another essential characteristic relies on its hierarchical nature. The five domains are

84 useful to retain the big picture of personality, maximize the situation consistency and

85 reliably assess difficult subjects such as children. Nonetheless, each dimension is

86 conceptualized as a latent construct formed by more specific narrow factors called facets,

87 which in turn are useful to depict the impact of personality characteristics into specific

88 behaviors and concrete life outcomes.

89   The Big Five has proven to be a valid theoretical and empirical model to predict

90 relevant life outcomes. Research such as Ozer and Benet-Martínez (2006) or Roberts, Kuncel,

91 Shiner, Caspi, and Goldberg (2007) has shown that scores for the Five Dimensions (and their

92 related facets) are able to explain outcomes such as Academic and work performance, health,

93 personality disorders, political attitudes and many more. The empirical findings linking Big

94 Five measures to life outcomes have reinforced the concurrent validity of the test scores

95 interpretations. At the same time, the broad nature of the domains has spurred research

96 into the more fine-grained lower order structure of facets.

97 **1.3. Facet Structures**

98   There are a number of models that include a facet structure below the five broad

99 domains. The most widely known model is the one suggested by Costa and McCrae (1995).

100 Other popular models have been suggested for the Big Five Inventory 2 (BFI-2; Soto & John,

101 2016), the IPIP (Goldberg et al., 2006), and the HEXACO model (Lee & Ashton, 2016),

102 which assumes six broad domains. Table 1 gives an overview of these different models listing

103 their facets per domain as well as some information regarding their psychometric properties.

104   < Table 1 >

Table 1

Different Big Five inventories

Taxonomy	Domains	Facets	Reliability	Validity	No. of items
HEXACO					200,100,60
	Humility		0.82	- creativity (Silvia, P., 2011)	
		Sincerity	0.66		
		Fairness	0.76		
		Greed Avoidance	0.81	- Social Dominance Orientation	
		Modesty	0.68	(Leone, L., 2012)	
	Emotionality		0.84		
		Fearfulness	0.7		
		Anxiety	0.64		
		Dependence	0.8		
		Sentimentality	0.7		
	Extraversion		0.85		
		Social	0.67		
		Self-Esteem			
		Social Boldness	0.76		
		Sociability	0.71		
		Liveliness	0.76		
	Agreeableness		0.84		
		Forgivingness	0.74		

Table 1

Different Big Five inventories (continued)

Taxonomy	Domains	Facets	Reliability	Validity	No. of items
		Gentleness	0.66		
		Flexibility	0.61		
		Patience	0.79		
	Conscientiousness		0.84		
		Organization	0.74		
		Diligence	0.7		
		Perfectionism	0.69		
		Prudence	0.69		
	Openness		0.81	+ Creativity (Silvia, p., 2011)	
		Aesthetic	0.66	- Right Wing Authoritarism	
		Unconventionality	0.52	(Leone, L., 2012)	
		Creativity	0.75		
		Inquisitiveness	0.66		
NEO-PI-r					240
	Neuroticism		0.92		
		Anxiety	0.78		
		Angry Hostility	0.75		
		Depression	0.81		
		Self-Consciousness	0.68		
		Impulsiveness	0.7		
		Vulnerability	0.77		
	Extraversion		0.89		
		Warmth	0.73		
		Gregariousness	0.72		
		Assertiveness	0.77		
		Activity	0.63		
		Excitement Seeking	0.65		
		Positive Emotions	0.73		
	Openness		0.87		
		Fantasy	0.76		
		Aesthetics	0.76		
		Feelings	0.66		
		Actions	0.58		
		Ideas	0.8		
		Values	0.67		

Table 1

Different Big Five inventories (continued)

Taxonomy	Domains	Facets	Reliability	Validity	No. of items
	Agreeableness		0.86		
		Trust	0.79		
		Straightforwardness	0.71		
		Altruism	0.75		
		Compliance	0.59		
		Modesty	0.67		
		Tender- Mindedness	0.56		
	Conscientiousness		0.9		
		Competence	0.67		
		Order	0.66		
		Dutifulness	0.62		
		Achievement Striving	0.67		
		Self-Discipline	0.75		
		Deliberation	0.71		
BFI-2			*		60
	Extraversion				
		Sociability	0.83		
		Assertiveness	0.8		
		Energy level	0.74		
	Agreeableness				
		Compassion	0.68		
		Respectfulness	0.66		
		Trust	0.75		
	Conscientiousness				
		Organization	0.76		
		Productiveness	0.74		
		Responsability	0.68		
	Negative Emotionality				
		Anxiety	0.79		
		Depression	0.74		
		Emotional Volatility	0.7		
	Open-mindedness				

Table 1

Different Big Five inventories (continued)

Taxonomy	Domains	Facets	Reliability	Validity	No. of items
		Intellectual curiosity	0.78		
		Aesthetic Sensitivity	0.67		
		Creative Imagination	0.67		
IPIP-NEO-120					120
	Neuroticism				
		Anxiety	0.78		
		Anger	0.87		
		Depression	0.85		
		Self-Consciousness	0.74		
		Inmoderation	0.72		
		Vulnerability	0.76		
	Extraversion				
		Friendliness	0.81		
		Gregariousness	0.79		
		Assertiveness	0.85		
		Activity Level	0.71		
		Excitement Seeking	0.77		
		Cheerfulness	0.8		
	Openness to Experience				
		Imagination	0.83		
		Artistic interests	0.76		
		Emotionality	0.69		
		Adventurousness	0.72		
		Intellect	0.75		
		Liberalism	0.64		
	Agreeableness				
		Trust	0.86		
		Morality	0.76		
		Altruism	0.76		
		Cooperation	0.73		

Table 1

Different Big Five inventories (continued)

Taxonomy	Domains	Facets	Reliability	Validity	No. of items
		Modesty	0.76		
		Sympathy	0.72		
	Conscientiousness				
		Self-Efficacy	0.63		
		Orderliness	0.83		
		Dutifulness	0.69		
		Achievement-striving	0.8		
		Self-Discipline	0.73		
		Cautiousness	0.87		

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 & Mõttus, 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 (John 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

148 correlations than their respective domain scores (e.g., Ziegler et al., 2012; . . .). However,

149 facet scores have also been shown to be related to personality disorders. Thus, the

150 combination of a higher fidelity along with the potential clinical relevance of facet scores

151 might open up unique advantages for clinical research.

1.4. The Big Five and Personality Disorders

153   Personality disorders are steadily shifting from a categorical definition into a continua

154 conceptualization within the clinical realm. This process is not new for personality science

155 history, as the subject itself moved from a qualitatively distinct set of definitions, called

156 types, into a subset of continuous domains in which both normality and extreme tendencies

157 were moving along, named traits. In fact, the new version of the Diagnostic and Statistical

158 Manual of mental disorders, DSM- V, now proposes two different ways of assessing

159 personality disorders: 1) A descriptive model of personality disorders in section II which

160 mimics the former model of assessing personality disorders and; 2) A novel trait model that

161 follows research on the personality scientific domain (In section III), which conceptualizes

162 personality disorders as extreme tendencies located in the continuum of the Big Five domains

163 and facets (American Psychiatric Association, 2013; Widiger & Mullins-Sweatt, 2009)

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

165 the Personality Disorder Inventory (PID-5; Krueger, Derringer, Markon, Watson, & Skodol,

166 2012), a 25-facet and five-dimension self-report inventory, with an informant-report version

167 (Markon, Quilty, Bagby, & Krueger, 2013). The big five dimensions mirror the Big Five

168 domains, although with a focus on the maladaptive end of the continuum,: I) Detachment

169 (Big Five's introversion), II) Antagonism (absence of Big Five's Agreeableness), III)

170 Disinhibition (absence of Big Five's Conscientiousness), IV) Negative affect (Big Five's

171 Neuroticism) and V) Psychoticism (Absence of Big Five's Openness). The PID-5 has shown

172 satisfying evidences of criterion validity (. . . summary). However, the limited number of

173 facets on the PID-5 has already raised some concerns due to the low reliability when

174 studying developmental phenomena of personality disorders (Clercq et al., 2014)', and may

175 also limit the capacity of portraying vivid personality profiles which are suitable for

176 explanatory purposes in the clinical domain.

177   In line with what has been stated previously for academic achievement, the

178 examination of facets may result in an enhancement of the specificity of assessment when

179 looking at the nature of PDs (Clark, 2005; Samuel & Widiger, 2008). This improvement of

180 specificity resulted in a predictive gain ranging from 3% to 16% when comparing facets to

181 domains predicting PD in the Reynolds and Clark (2001) study. Furthermore, the use of

182 facets may be of extreme utility for those PD whose personality profile is less clear at the

183 domain level. As Saulsman and Page (2004) point out, Schizotypal and

184 Obsessive-Compulsive disorders are examples of PD which are not well covered by Big Five

185 domains. A reason for it may be found in a pattern inconsistency of facets within the same

186 dimension or in a lack of coverage for essential characteristics of the PD. For example,

187 aberrant cognitions are essential characteristics of schizotypal disorder and are not covered

188 by some instrument's facets like the NEO-PI-R (Samuel & Widiger, 2008; Saulsman & Page,

189 2004). Likewise, the expected high scores on warmth and low scores on assertiveness could

190 mask the effects of extraversion when predicting Dependent Personality Disorder, following

191 the theoretical correspondence between PD and Big Five facets proposed by Costa Jr. and

192 Widiger (1994). Moreover, the PID-5 has prompted the elaboration of a number of Five

193 Factor Model Personality Disorders (FFMPD) scales to maximize the facet coverage in

194 relation to specific PDs (Bagby & Widiger, 2018).

195   Facet analysis and dedicated Big Five questionnaires have been used to solve issues like

196 those mentioned in the last paragraph. We propose to base such research on a broader facet

197 basis. To this end we suggest a general instrument to cover a broad number of facets which

198 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 bachellor 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 Strucutural 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 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

²²⁴ **2.1.1. Participants.** The sample consisted of 726 American undergraduate students
²²⁵ (59.3% male) who participated voluntarily. The mean age was 21.6 years (SD=5.9). Students
²²⁶ were emailed a link to a computerized assessment battery that included the IPIP items as
²²⁷ well as several other tests not reported in this paper. The data set was randomly splitted in
²²⁸ two equally sized samples. Both samples were matched in relation to missing values, outliers
²²⁹ and extreme values. In Sample 1 the mean age was 21.8 years (SD=6.3), in Sample 2 the
²³⁰ mean age was 21.5 years (SD=5.6).

²³¹ **2.1.2. Measures.**

²³² **International Personality Item Pool (IPIP).** Altogether, 525 items from the
²³³ *International Personality Item Pool* (IPIP) were used to measure Neuroticism, Extraversion,
²³⁴ Openness (to experience), Agreeableness and Conscientiousness. The IPIP is an open source
²³⁵ database of personality items, which was launched in 1996, and contains over 2000 items
²³⁶ (Goldberg et al., 2006). Participants were asked to rate themselves on typical behaviors or
²³⁷ reactions on a 5-point Likert scale, ranging from 1 ("Not all like me") to 5 ("Very much like
²³⁸ me").

²³⁹ **GPA.** This measures academic achievement.

²⁴⁰ **Satisfaction With Life (SWL).** Scale of satisfaction with life

²⁴¹ **2.1.3. Procedure**

²⁴² **EFA with subsample 1.** To determine the number of possible facets per domain
²⁴³ Velicer (1976) Minimum Average Partial (MAP) method and Horn (1965) parallel analysis
²⁴⁴ (PA) were employed for every domain. Based on these results an exploratory factor analysis
²⁴⁵ was calculated for each domain via Mplus using a geomin rotation (Quelle) and a maximum
²⁴⁶ likelihood estimator (ML). The decision for the preferred number of facets per domain was
²⁴⁷ based partly on comparing model fits (CFI, RMSEA, SRMR). More importantly though was
²⁴⁸ the interpretability of the facet solution. After all facet solutions of other personality
²⁴⁹ measures were looked at to compare it to the found facet structure. If there were important

₂₅₀ parts missing to present the domain with regards to content, new facets would be added
₂₅₁ afterwards.

₂₅₂ **CFA and ESEM with subsample 2.**   To confirm the structure of facets the EFAs
₂₅₃ delivered, multiple confirmatory factor analyses were calculated via Mplus. In a first step
₂₅₄ measurement models were estimated for each of the facets. To obtain balance between the
₂₅₅ facets, the items were reduced to five per facet based on item content and loading pattern in
₂₅₆ a second step, afterwards the estimations for the measurement models on facet levels were
₂₅₇ repeated. For both steps estimators were WLSMV (weighted least squares adjusted for
₂₅₈ means and variances). Aim was to ensure an optimal breadth and sufficient reliability. In a
₂₅₉ final model, all five domain structural models were integrated using exploratory structural
₂₆₀ equation modeling (ESEM) (Asparouhov & Muthén, 2009). Marsh et al. (2010) could show
₂₆₁ that ESEM fits personality data better and results in substantially more differentiated
₂₆₂ factors than it would using CFA, while using an EFA measurement model with rotations in a
₂₆₃ structural equation model. All facets were able to load on all domains. If there would show
₂₆₄ up facets that do not significantly load on the intended domain, this facets would get
₂₆₅ eliminated subsequently. The estimators used were ML, factor scores were used as indicators
₂₆₆ and the rotation was oblique (using Geomin). Model fit was determined based on the guide
₂₆₇ lines by Hu and Bentler (1999) as well as Beauducel and Wittmann (2005). Consequently, to
₂₆₈ consider a good fit of a proposed model, the Comparative Fit Index (CFI) should be at or
₂₆₉ over .95, the standardized root mean squared residual (SRMR) smaller than .08 and the root
₂₇₀ mean square error of approximation (RMSEA) smaller than .06.

₂₇₁ **Criterion validity evidence.**   To examine the nomological structure of the facets
₂₇₂ and domains to external constructs like life satisfaction and education, correlations and
₂₇₃ multiple regression were computed.

₂₇₄ **2.2. Results**

²⁷⁵   **Results of EFA.**   In *Table 2* model fits for the chosen facet model for each domain

²⁷⁶ are shown, as well as Eigenvalues and results from MAP and PA test. To ensure the

²⁷⁷ homogeneity of the facets and to reduce the risk of cross domain loadings, items with factor

²⁷⁸ loadings less than .30 were eliminated. This was only done when item content was also

²⁷⁹ judged as being non-central to the domain in question (John et al., 2014).

²⁸⁰   < Table 2 here>

²⁸¹   According to the exploratory model, **Agreeableness** consists of eight facets after two

²⁸² facets were eliminated due to weakly loading and inconsistent items. The remaining facets

²⁸³ are named Appreciation, Integrity, Low Competitiveness, Readiness to Give Feedback,

²⁸⁴ Search for Support, Good Faith, Genuineness and Altruism. **Conscientiousness** consists of

²⁸⁵ nine facets after one facet with item factor loadings less than .30 was excluded, they are:

²⁸⁶ Dominance, Persistence, Self-discipline, Task planning, Goal orientation, Carefulness,

²⁸⁷ Orderliness, Wish to work to capacity and Productivity. **Extraversion** is formed by nine

²⁸⁸ facets. A new facet (Energy) was added in order to tap better the physical component of

²⁸⁹ Extraversion, which was missing in the eight facet solution. The facets are Sociability,

²⁹⁰ Readiness to take risks, Wish for affiliation, Positive attitude, Forcefulness,

²⁹¹ Communicativeness, Humor, Conviviality and Energy. **Neuroticism** (interpreted here as

²⁹² emotional stability) consists of seven facets. One facet was dropped due to poor

²⁹³ interpretability, and was therefore not included in the subsequent analyses. The final set of

²⁹⁴ facets are named Equanimity, Confidence, Carefreeness, Mental balance, Drive, Emotional

²⁹⁵ robustness and Self-attention. **Openness** to experience comprises of nine facets. One facet

²⁹⁶ was identified as a method factor and eliminated, because it solely contained negatively

²⁹⁷ formulated items and no coherent underlying trait could be identified. Furthermore another

²⁹⁸ facet (Intellect) was added, because the remaining facets lacked an intellectual content. The

²⁹⁹ facets of Openness are named Creativity, Wish for variety, Open-mindedness, Interest in

³⁰⁰ reading, Artistic interests, Wish to analyze, Willingness to learn, Sensitivity and Intellect.

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

302   **Results of CFA and ESEM.**   All measurement models for the facets were fitting

303   well, results can be found in *Table 3*. In this table both five-item facets and multiple-item

304   facets are presented with their respectve model fit measures. The 5-item facets normally

305   outperform the multiple-item facet versions regarding model fit.

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

307   The exploratory structural equation model (ESEM) of the final model with all five

308   domains fits well with CFI = .87, RMSEA = .072, SRMR = .036. As you can see in *Table 4*

309   nearly all facets load significantly on their intended domain. Some cross loadings can be

310   found as they are plausible with ESEM procedures. However, in any case the number of

311   cross loadings is high nor against the facet content.

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

313   **Criterion validity evidence.**   < Table 5 here caption="Criterion correlations" >

314   **Study 2 – German Sample**

315   **Participants.**   The representative sample consisted of 387 German speakers (49.1%

316   male) with a mean age of 45.6 years (SD = 17.5). (How was the data collected?)

317   **Measures.**   The five items per facet derived from Study 1 were translated and

318   back-translated by bilingual experts, creating a German version of the measure used there.

319   The translated items can be found on appendix B.

320   **Procedure**

321   **Step 1 – Examining the structure.**   To check the facet structure Study 1

322   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

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 Δ

CFI $< .01$, Δ RMSEA $< .015$ and Δ SRMR $< .03$, at which the limit to strong factorial

measurement invariance was set to Δ CFI $< .01$, Δ RMSEA $< .015$, Δ SRMR $< .01$ (Chen,

2007).

Results

Results of 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 3. The ESEM with

all five domains fits well 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

348 measurement invariance is assumed for the facets Appreciation of others,

349 Superiority/Grandiosity, Need to be liked, Crybabiness, Manipulation, Altruism (facets of

350 Agreeableness), Perseverance, Task Planning, Goal-orientation/Achievement striving,

351 Preferred Load, Procrastination (facets of Conscientiousness), Assertiveness,

352 Sociability/Gregariousness, Activity (facets of Extraversion), Irritability, Self-serving

353 Attention (facets of Neuroticism), Self-attributed Inginuity, Openness to actions and

354 activities, Openmindedness/Judgement, Love of Learning, Openness to feelings and Intellect

355 (facets of Openness).

356 Factorial measurement invariance is assumed for the facets Meanness, Trust (facets of

357 Agreeableness), Control of others, Lack of (Self-) Control, Deliberation/Caution, Lack of

358 Tidiness/Order (facets of Conscientiousness), Sensation Seeking, Reclusiveness, Emotionality,

359 Humor (facets of Extraversion), Depression, Anxiety, Self-assuredness, Lethargia,

360 Sentimentality (facets of Neuroticism), Openness to reading, Openness to arts and Need for

361 cognition (facets of Openness).

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

363 Extraversion

364 <Table 7 here>

365   **Discussion**

366 We have presented an open access instrument for personality assessment within the Big

367 Five framework, which showed evidences of factorial validity in two different cultures and

368 maximized the space set of facets encompassed. Furthermore, evidences for external criteria

369 validity were attained

370 We cover all the "core" facets proposed by soto and john. We also cover all the facets

371 proposed by the most influential Big Five measures as seen in table 1. In addition we

372 included even more facets.

³⁷³ The evidences for reliability and structural validity are retained. Like most of the Big

³⁷⁴ Five instruments, ours could not survive to the CFA independent cluster model. Even

³⁷⁵ though ESEM has been used to provide structural validity evidence of personality measures

³⁷⁶ recently. Here we show that the standards for a good ESEM model are met. Furthermore

³⁷⁷ the structural validity is robust between two different cultures.

³⁷⁸ We have collected some criterion validity evidences. Like bla bla bla. Nonetheless the

³⁷⁹ multi - facetted nature of the instrument makes forthcoming evidences for criterion and

³⁸⁰ predictive validity promising.

³⁸¹ One limitation is the sample used. Students are not a representative population of

³⁸² society and results may not be generalized.

³⁸³ Future directions are to provide a tool with the subset of items for public use. Gather

³⁸⁴ community sample, from more cultures and test the extent of the universality of the

³⁸⁵ instrument. And use the instrument to predict important life outcomes so the links between

³⁸⁶ specific behaviors and facets become richer.

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Table captions

Table 1. Different Big Five inventories

Table 2. Results for the EFA on the Big Five domains

Table 3. Model fit for each facet

Table 4. ESEM factor scores USA sample

Table 5. Criterion correlations

Table 6. ESEM factor scores German sample

Table 7. Measurement invariance

Table 2

Results for the EFA on the Big Five domains

Domains (number of chosen factes for EFA)	Chi-squared (df)	CFI	RMSEA	SRMR	Eigenvalues	MAP	PA
Agreeableness (10)	6477.67*** (4363)	0.837	0.039	0.034	42.99	8	9
Conscientiousness (10)	8377.56*** (5243)	0.827	0.041	0.034	51.09	8	10
Extraversion (8)	4643.64*** (2620)	0.837	0.046	0.036	38.25	8	10
Neuroticism (8)	9346.97 *** (5987)	0.836	0.039	0.034	53.50	8	7
Openness (9)	8178.52*** (5142)	0.824	0.040	0.036	47.41	8	11

Table 3

Model fit for each facet

| | | USA sample | | | | | | | | | German sample | | | |
| | | Full items | | | | 5 items | | | | | | | | |
facets	items	chisq(df)	pvalue	cfi	rmsea	items	chisq(df)	pvalue	cfi	rmsea	chisq(df)	pvalue	cfi	rmsea
a1	38	1542.056(665)	<.001	0.983	0.061	5	7.686(5)	0.174	0.999	0.039	15.141(5)	0.01	0.990	0.072
a2	12	192.909(54)	<.001	0.962	0.085	5	1.677(5)	0.892	1.000	0.000	34.724(5)	< 0.001	0.974	0.124
a3	13	299.64(65)	<.001	0.955	0.100	5	1.031(5)	0.96	1.000	0.000	28.603(5)	< 0.001	0.964	0.110
a4	6	20.43(9)	0.015	0.955	0.059	5	6.628(5)	0.25	0.993	0.030	20.642(5)	< 0.001	0.951	0.090
a5	9	110.001(27)	<.001	0.924	0.092	5	10.469(5)	0.063	0.986	0.055	65.262(5)	< 0.001	0.882	0.176
a6	5	19.051(5)	0.002	0.988	0.088	5	19.051(5)	0.002	0.988	0.088	15.098(5)	0.01	0.991	0.072
a7	10	120.229(35)	<.001	0.950	0.082	5	2.935(5)	0.71	1.000	0.000	29.404(5)	< 0.001	0.965	0.112
a8	4	0.257(2)	0.88	1.000	0.000	4	0.257(2)	0.88	1.000	0.000	6.636(2)	0.036	0.932	0.077
c1	5	24.279(5)	<.001	0.968	0.103	5	24.279(5)	<.001	0.968	0.103	19.883(5)	0.001	0.989	0.088
c2	8	61.253(20)	<.001	0.957	0.076	5	12.891(5)	0.024	0.990	0.066	8.72(5)	0.121	0.995	0.044
c3	22	745.063(209)	<.001	0.954	0.084	5	8.415(5)	0.135	0.995	0.044	36.07(5)	< 0.001	0.937	0.127
c4	31	1797.919(434)	<.001	0.948	0.093	5	2.803(5)	0.73	1.000	0.000	47.719(5)	< 0.001	0.977	0.149
c5	7	46.654(14)	<.001	0.990	0.080	5	5.805(5)	0.326	1.000	0.021	154.106(5)	< 0.001	0.909	0.278
c6	13	246.462(65)	<.001	0.943	0.088	5	8.102(5)	0.151	0.994	0.042	18.672(5)	0.002	0.978	0.084
c7	9	167.801(27)	<.001	0.972	0.120	5	9.901(5)	0.078	0.998	0.052	92.76(5)	< 0.001	0.954	0.213
c8	7	61.832(14)	<.001	0.952	0.097	5	5.998(5)	0.306	0.999	0.024	35.668(5)	< 0.001	0.954	0.126
c9	6	19.842(9)	0.019	0.977	0.058	5	8.007(5)	0.156	0.993	0.041	19.16(5)	0.002	0.979	0.086
e1	6	44.056(9)	<.001	0.966	0.104	5	7.139(5)	0.21	0.997	0.034	6.341(5)	0.274	0.997	0.026
e2	6	62.838(9)	<.001	0.959	0.129	5	21.787(5)	0.001	0.985	0.097	44.117(5)	< 0.001	0.966	0.142
e3	10	173.741(35)	<.001	0.955	0.105	5	9.454(5)	0.092	0.995	0.050	50.828(5)	< 0.001	0.943	0.154
e4	11	129.99(44)	<.001	0.987	0.074	5	0.793(5)	0.977	1.000	0.000	29.172(5)	< 0.001	0.989	0.112
e5	14	606.141(77)	<.001	0.923	0.138	5	11.069(5)	0.05	0.990	0.058	6.587(5)	0.253	0.998	0.029
e6	9	124.476(27)	<.001	0.942	0.100	5	11.351(5)	0.045	0.991	0.059	127.563(5)	< 0.001	0.883	0.252
e7	11	117.666(44)	<.001	0.983	0.068	5	9.437(5)	0.093	0.997	0.050	28.17(5)	< 0.001	0.983	0.109
e8	11	260.004(44)	<.001	0.963	0.117	5	8.777(5)	0.118	0.995	0.046	31.239(5)	< 0.001	0.981	0.116
e9	3	0(0)	NA	1.000	0.000	3	0(0)	NA	1.000	0.000	0(0)	< 0.001	1.000	0.000
n1	24	786.655(252)	<.001	0.966	0.077	5	4.999(5)	0.416	1.000	0.000	29.498(5)	< 0.001	0.974	0.113
n2	24	804.26(252)	<.001	0.966	0.078	5	5.553(5)	0.352	1.000	0.018	57.719(5)	< 0.001	0.981	0.165
n3	26	977.324(299)	<.001	0.968	0.079	5	4.391(5)	0.495	1.000	0.000	14.337(5)	0.014	0.990	0.069
n4	18	348.187(135)	<.001	0.977	0.066	5	4.333(5)	0.503	1.000	0.000	43.461(5)	< 0.001	0.950	0.141
n5	6	21.737(9)	0.01	0.983	0.063	5	8.177(5)	0.147	0.995	0.042	22.031(5)	< 0.001	0.972	0.094
n6	12	533.129(54)	<.001	0.894	0.157	5	8.112(5)	0.15	0.996	0.042	15.515(5)	0.008	0.988	0.074
n7	3	0(0)	NA	1.000	0.000	3	0(0)	NA	1.000	0.000	0(0)	< 0.001	1.000	0.000
o1	11	121.457(44)	<.001	0.978	0.070	5	9.098(5)	0.105	0.996	0.048	6.403(5)	0.269	0.997	0.027
o3	18	376.508(135)	<.001	0.977	0.070	5	10.098(5)	0.073	0.994	0.053	100.749(5)	< 0.001	0.869	0.222
o4	8	24.754(20)	0.211	1.000	0.026	5	1.941(5)	0.857	1.000	0.000	17.058(5)	0.004	0.998	0.079
o5	9	61.23(27)	<.001	0.989	0.059	5	7.855(5)	0.164	0.999	0.040	5.175(5)	0.395	1.000	0.010
o6	11	120.437(44)	<.001	0.983	0.069	5	4.815(5)	0.439	1.000	0.000	7.965(5)	0.158	0.998	0.039
o7	12	214.086(54)	< .001	0.980	0.091	5	3.399(5)	0.639	1.000	0.000	7.74(5)	0.171	0.999	0.038

Table 4

ESEM factor scores USA sample

facet	Agreeableness	Conscientiousness	Extraversion	Neuroticism	Openness
A1	**-0.383***	0.124	0.261***	0.095	0.446***
A2	**0.638***	-0.218*	-0.181**	0.130	-0.099
A3	**0.757***	0.058	0.063	0.102	0.118
A6	**-0.229***	0.007	0.407***	0.226**	0.137
A7	**0.635***	-0.172	-0.034	0.144	-0.001
A8	**-0.347***	-0.003	0.246***	0.132	0.334***
C1	0.677***	**0.273***	0.081	0.041	0.177
C2	0.033	**-0.325**	-0.203**	0.457***	-0.169*
C3	0.265***	**-0.302*	0.096	0.533***	0.163*
C4	0.183*	**0.816***	-0.097	0.034	0.012
C5	0.068	**0.681***	0.133	-0.147	0.184*
C6	-0.071	**0.585***	-0.194*	0.013	0.321***
C7	0.032	**-0.46***	0.045	0.364***	0.185**
C8	0.054	**0.35***	0.114	0.148*	0.191*
C9	0.12*	**0.4***	0.077	-0.24**	0.16*
E1	-0.082	0.015	**-0.746***	0.025	-0.002
E3	0.045	0.078	**-0.694***	0.029	0.456***
E4	-0.081	0.169*	**0.547***	-0.163	0.249***
E5	0.6***	0.039	**0.196***	-0.007	0.398**
E6	0.113	-0.077	**0.699***	0.36***	-0.001
E7	0.080	-0.203**	**0.289***	-0.027	0.414***
E8	0.048	0.012	**0.744***	0.137	0.083
E9	0.106	0.042	**0.492***	-0.264***	0.110
N1	0.46***	0.011	-0.055	**0.389***	-0.135
N2	0.052	-0.100	-0.489***	**0.54***	0.083
N3	0.003	0.144	-0.243**	**0.755***	0.090
N4	0.204*	-0.013	0.064	**-0.411***	0.537***
N5	0.027	-0.365**	-0.234**	**0.587***	0.006
N6	-0.162	0.247*	0.055	**0.729***	-0.129
N7	0.136*	0.106	0.009	**0.629***	-0.089
O1	0.220	-0.236***	-0.014	-0.158**	**0.806***
O2	-0.184**	0.121	0.284***	0.038	**0.42***
O3	-0.082	-0.012	0.066	-0.095	**0.768***
O4	-0.208**	-0.040	-0.173**	0.107	**0.543***
O5	-0.27**	-0.095	0.031	0.056	**0.586***
O6	-0.001	0.154*	-0.152*	0.065	**0.776***
O7	-0.246**	0.137*	0.044	-0.050	**0.706***
O9	0.073	0.17**	-0.114	-0.197***	**0.623***

Table 5

Criterion correlations

facets	lifesat	sattotal	satverb	satquant	gpa_cc	gpa_univ	hsgpa
A1	0.16	0.03	0.04	0.03	**-0.21**	-0.03	-0.13
A2	0.19	0.02	-0.02	0.03	-0.06	-0.05	-0.17
A3	0.03	-0.02	-0.14	-0.11	0.11	-0.01	-0.02
A4	-0.05	0.08	0.13	0.1	**-0.22**	-0.12	-0.09
A5	-0.18	-0.06	0.03	-0.1	-0.03	0.02	0.03
A6	**0.25**	-0.02	-0.06	0.02	-0.14	-0.04	-0.16
A7	0.12	-0.05	-0.15	-0.15	-0.03	-0.01	-0.17
A8	0.14	0.02	0.14	0.05	-0.15	-0.13	-0.15
C1	0.03	0.04	**0.21**	0.19	-0.09	-0.03	-0.06
C2	**0.27**	-0.04	-0.07	-0.02	-0.05	-0.10	-0.12
C3	0.19	-0.06	-0.05	-0.03	0.06	-0.06	-0.13
C4	**0.2**	-0.06	0	-0.02	-0.18	-0.07	-0.17
C5	**0.28**	-0.07	0.01	0.02	-0.14	-0.15	**-0.22**
C6	**0.23**	0.00	0.09	0.1	-0.15	-0.01	-0.16
C7	0.11	-0.09	-0.17	-0.11	-0.07	-0.01	-0.14
C8	0.1	-0.04	0.07	0.05	-0.14	0.02	-0.12
C9	**0.23**	-0.02	-0.05	-0.06	**-0.25**	-0.08	-0.13
E1	**0.26**	-0.03	0.01	-0.1	0.02	0.04	-0.11
E2	0	0.02	0.02	-0.04	0.05	0.08	0.14
E3	**0.2**	-0.12	-0.15	-0.16	0.12	0.00	-0.06
E4	**0.49**	-0.08	-0.09	-0.07	-0.04	-0.01	-0.07
E5	0.09	-0.05	0.11	0.03	-0.04	0.03	-0.01
E6	0.11	-0.01	0.05	-0.09	-0.04	-0.01	-0.06
E7	0.16	0.16	0.15	0.1	-0.05	0.04	-0.03
E8	**0.22**	-0.03	0.02	-0.04	-0.07	0.04	-0.06
E9	**0.25**	-0.05	-0.03	-0.02	-0.09	-0.04	-0.06
N1	**0.22**	0.03	0	0.02	0.07	-0.09	-0.11
N2	**0.53**	-0.04	-0.12	-0.05	-0.01	-0.04	-0.09
N3	**0.31**	-0.03	-0.07	-0.06	0.08	0.07	0.01
N4	**0.25**	0.10	0.13	0.14	-0.02	0.01	-0.03
N5	**0.27**	-0.02	-0.07	-0.01	-0.04	-0.05	-0.08
N6	0.18	0.01	0.01	0.07	0.19	0.03	0.06
N7	**0.21**	-0.08	-0.15	-0.18	0.07	0.04	-0.01
O1	0.06	0.01	0.02	-0.06	-0.15	0.03	0.01
O2	0.18	0.03	0.06	-0.02	-0.08	0.01	-0.1
O3	**0.22**	-0.04	0.05	0.03	**-0.23**	0.09	-0.15
O4	0.07	0.13	**0.25**	0.06	**-0.24**	-0.05	-0.16
O5	0.04	-0.02	0.08	-0.08	-0.12	0.11	-0.05
O6	0.13	0.11	**0.24**	0.17	**-0.23**	0.01	-0.1
O7	**0.21**	0.07	0.14	0.11	**-0.2**	-0.04	-0.1
O8	0.18	-0.02	0.08	-0.07	-0.1	0.04	-0.12
O9	**0.24**	0.16	**0.27**	**0.26**	-0.17	-0.02	**-0.21**

Table 6

ESEM factor scores German sample

facet	Agreeableness	Conscientiousness	Extraversion	Neuroticism	Openness
A1	**-0.383*****	0.124	0.261***	0.095	0.446***
A2	**0.638*****	-0.218*	-0.181**	0.130	-0.099
A3	**0.757*****	0.058	0.063	0.102	0.118
A6	**-0.229*****	0.007	0.407***	0.226**	0.137
A7	**0.635*****	-0.172	-0.034	0.144	-0.001
A8	**-0.347*****	-0.003	0.246***	0.132	0.334***
C1	0.677***	**0.273*****	0.081	0.041	0.177
C2	0.033	**-0.325****	-0.203**	0.457***	-0.169*
C3	0.265***	**-0.302****	0.096	0.533***	0.163*
C4	0.183*	**0.816*****	-0.097	0.034	0.012
C5	0.068	**0.681*****	0.133	-0.147	0.184*
C6	-0.071	**0.585*****	-0.194*	0.013	0.321***
C7	0.032	**-0.46*****	0.045	0.364***	0.185**
C8	0.054	**0.35*****	0.114	0.148*	0.191*
C9	0.12*	**0.4*****	0.077	-0.24**	0.16*
E1	-0.082	0.015	**-0.746*****	0.025	-0.002
E3	0.045	0.078	**-0.694*****	0.029	0.456***
E4	-0.081	0.169*	**0.547*****	-0.163	0.249***
E5	0.6***	0.039	**0.196*****	-0.007	0.398**
E6	0.113	-0.077	**0.699*****	0.36***	-0.001
E7	0.080	-0.203**	**0.289*****	-0.027	0.414***
E8	0.048	0.012	**0.744*****	0.137	0.083
E9	0.106	0.042	**0.492*****	-0.264***	0.110
N1	0.46***	0.011	-0.055	**0.389*****	-0.135
N2	0.052	-0.100	-0.489***	**0.54*****	0.083
N3	0.003	0.144	-0.243**	**0.755*****	0.090
N4	0.204*	-0.013	0.064	**-0.411*****	0.537***
N5	0.027	-0.365**	-0.234**	**0.587*****	0.006
N6	-0.162	0.247*	0.055	**0.729*****	-0.129
N7	0.136*	0.106	0.009	**0.629*****	-0.089
O1	0.220	-0.236***	-0.014	-0.158**	**0.806*****
O2	-0.184**	0.121	0.284***	0.038	**0.42*****
O3	-0.082	-0.012	0.066	-0.095	**0.768*****
O4	-0.208**	-0.040	-0.173**	0.107	**0.543*****
O5	-0.27**	-0.095	0.031	0.056	**0.586*****
O6	-0.001	0.154*	-0.152*	0.065	**0.776*****
O7	-0.246**	0.137*	0.044	-0.050	**0.706*****
O9	0.073	0.17**	-0.114	-0.197***	**0.623*****

Table 7

Measurement invariance

	Configural MI	Factorial MI	Strong Factorial MI
Agreeableness	Appreciation	Meanness	Shyness
	Low Competitiveness	Trust	
	Crybabiness		
	Manipulation		
	Altruism		
Conscientiousness	Perseverance	Control of others	
	Task planning	Lack of self-control	
	Goal-orientation	Deliberation/Caution	
	Preferred Load	Lack of tidiness	
	Procrastination		
Extraversion	Assertiveness	Sensation seeking	
	Sociability	Reclusiveness	
	Energy	Emotionality	
		Humor	
Neuroticism	Irritability	Depression	
	Self-serving attention	Anxiety	
		Self-assuredness	
		Lethargia	
		Sentimentality	
Openness to Experience	Creativity	Openness to reading	
	Openness to actions	Openness to arts	
	Openmindedness	Need for cognition	
	Love of learning		
	Openness to feelings		