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 nature 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 (John et al., 2014; Lounsbury, Sundstrom, Loveland, & Gibson, 2002; Paunonen & Ashton, 2001). 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.

1.1   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 & 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 (Fiske (1949); Norman (1967); Tupes & Christal (1961); Borgatta (1964)). Possibly the two most widely cited works relating to the foundations of the Big Five are those by Goldberg et al. (2006) and Costa & McCrae (1995). Goldberg can be seen as one of the first who extended research concerning the Big Five, while McRae 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. 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 & Benet-Martínez (2006) or Roberts, Kuncel, Shiner, Caspi, & Goldberg (2007) 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 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.

1.2 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 & 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.

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However, there is still a degree of overlap on the facets covered by the different instruments. Soto & 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 & 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 & 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 & 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, & 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 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.

1.3   The Big Five and Personality Disorders

Personality disorders are steadily shifting from a categorical definition into a continua 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 (Clercq et al., 2014)', 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 & 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 & 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. & 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.

1.4   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.

2.1 Study 1 - US-American Sample

2.1.1 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. 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 21.8 years (SD=6.3), in Sample 2 the mean age was 21.5 years (SD=5.6).

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2.2 Measures.

2.2.1 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").

2.2.2 GPA

This measures academic achievement.

2.2.3 Satisfaction With Life (SWL)

Scale of satisfaction with life

2.3 Procedure

2.3.1 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 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. After all facet solutions of other personality measures were looked at to compare it to the found facet structure. If there were important parts missing to present the domain with regards to content, new facets would be added afterwards.

2.3.2 CFA and ESEM with subsample 2

To confirm the structure of facets the EFAs delivered, multiple confirmatory factor analyses 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, afterwards the estimations for the measurement models on facet levels were 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 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 & Bentler (1999) as well as Beauducel & 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.

Table 1: 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

2.3.3 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.

2.4 Results

2.4.1 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 (John 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).

2.4.2   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 respectve 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 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 4* nearly

Table 2: 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
o8	4	18.101(2)	<.001	0.953	0.150	4	18.101(2)	<.001	0.953	0.150	118.726(2)	< 0.001	0.842	0.388
o9	3	0(0)	NA	1.000	0.000	3	0(0)	NA	1.000	0.000	0(0)	< 0.001	1.000	0.000

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 nor against the facet content.

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

Table 3: ESEM factor scores USA sample

X2	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*****

2.4.3   Criterion validity evidence

< Table 5 here caption="Criterion correlations" >

Table 4: 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**

2.5 Study 2 – German Sample

2.5.1 Participants

The representative sample consisted of 387 German speakers (49.1% male) with a mean age of 45.6 years (SD = 17.5). (How was the data collected?)

2.5.2   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.

2.6   Procedure

2.6.1   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).

2.6.2   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).

2.7 Results

2.7.1 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 >

2.7.2 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 Inginuity, 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,

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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>

3   Discussion

We have presented 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. Furthermore, evidences for external criteria validity were attained

We cover all the "core" facets proposed by soto and john. We also cover all the facets proposed by the most influential Big Five measures as seen in table 1. In addition we included even more facets.

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

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

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

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

Appendix A

Table 5: Items of the new measure and their corresponding facets and domains

Domain	Facet	Item
Agreeableness	A1: Appreciation	I acknowledge others' accomplishments.
		I respect others' feelings.
		I respect others.
		I am a good listener.
		I am polite to strangers.
	A2: Integrity	I speak ill of others. (-)
		I insult people. (-)
		I do things out of revenge. (-)
		I misuse power. (-)
		I try to avoid doing favors for others. (-)
	A3: Low competitiveness	I would like to have more power than other people. (-)
		I want to control the conversation. (-)
		I tend to brag about my accomplishments. (-)
		I want to be told I am right. (-)
		I see other people as my competitors. (-)
	A4: Readiness to give feedback	I want to be liked.
		I do what others want me to do.
		I change myself to suit others.
		I am afraid of providing criticism.
		I find it necessary to please the people who have power.

Domain	Facet	Item
	A5: Search for support	I show my sadness.
		I show my fear.
		I show my anger.
		I tend to complain.
		I seek support.
	A6: Good faith	I trust what people say.
		I trust others.
		I believe that others have good intentions.
		I am good at working with a group.
		I feel like a loser if I compromise. (-)
	A7: Genuineness	I lie to get myself out of trouble. (-)
		I respect authority.
		I try to fool others. (-)
		I find it easy to manipulate others. (-)
		I use flattery to get ahead. (-)
	A8: Altruism	I think of others first.
		I let other people take the credit for my work.
		I try to respond with understanding when someone treats me badly.
		I return extra change when a cashier makes a mistake.

Table 5: Items of the new measure and their corresponding facets and domains *(continued)*

Domain	Facet	Item
Conscientiousness	C1: Dominance	I want to be in charge.
		I try to lead others.
		I demand perfection in others.
		I resist authority.
		I try to outdo others.
	C2: Persistence	I give up easily. (-)
		I never give up.
		I am easily discouraged. (-)
		I like to take my time. (-)
		My interests change quickly. (-)
	C3: Self-discipline	I am easily talked into doing silly things. (-)
		I rush into things. (-)
		I act impulsively when something is bothering me. (-)
		I am easily distracted. (-)
		I say inappropriate things. (-)
	C4: Task planning	I do things according to a plan.
		I follow a schedule.
		I make plans and stick to them.
		I want things to proceed according to plan.
		I am always prepared.

Table 5: Items of the new measure and their corresponding facets and domains *(continued)*

Domain	Facet	Item
	C5: Goal orientation	I accomplish a lot of work.
		I work hard.
		I put little time and effort into my work. (-)
		I am a goal-oriented person.
		I carry out my plans.
	C6: Carefulness	I choose my words with care.
		I look at the facts.
		I make careful choices.
		I avoid mistakes.
		I take precautions.
	C7: Orderliness	I leave a mess in my room. (-)
		I often forget to put things back in their proper place. (-)
		I am continually losing things. (-)
		I can never find anything. (-)
		I make a mess of things. (-)
	C8: Wish to work to capacity	I work too much.
		I have extra time on my hands. (-)
		I am always busy.
		I have too many things to do.
		I am exacting in my work.

Table 5: Items of the new measure and their corresponding facets and domains *(continued)*

Domain	Facet	Item
	C9: Productivity	I can manage many things at the same time.
		I start tasks right away.
		I can't wait to get started on a project.
		I finish tasks quickly.
		I stop when work becomes too difficult.
Extraversion	E1: Sociability	I am quiet around strangers. (-)
		I start conversations.
		I feel comfortable only with friends. (-)
		I feel comfortable around people.
		I have difficulty showing affection. (-)
	E2: Readiness to take risks	I seek danger.
		I enjoy being reckless.
		I avoid dangerous situations. (-)
		I act wild and crazy.
		I like loud music.
	E3: Wish for affiliation	I prefer to be alone. (-)
		I enjoy spending time by myself. (-)
		I enjoy silence. (-)
		I feel isolated from other people. (-)
		I hold back my opinions. (-)

Table 5: Items of the new measure and their corresponding facets and domains *(continued)*

Domain	Facet	Item
	E4: Positive attitude	I look forward to each new day.
		I look at the bright side of life.
		I love life.
		I laugh a lot.
		I feel lucky most of the time.
	E5: Forcefulness	I automatically take charge.
		I do most of the talking.
		I know how to convince others.
		I like having authority over others.
		I challenge others' points of view.
	E6: Communicativeness	I talk a lot.
		I like talking about myself.
		I easily share my feelings with others.
		I love to chat.
		I disclose my intimate thoughts.
	E7: Humor	I am known for my sense of humor.
		I try to add some humor to whatever I do.
		I like to amuse others.
		I try to tease my friends out of their gloomy moods.
		I amuse myself easily.

Domain	Facet	Item
	E8: Conviviality	I enjoy being part of a group.
		I enjoy teamwork.
		I am good at planning group activities.
		I would enjoy a lot of social interaction.
		I am good at getting people to like me.
	E9: Energy	I maintain high energy throughout the day.
		I tire out quickly. (-)
		I am usually active and full of energy.
Neuroticism	N1: Equanimity	I get angry easily. (-)
		I snap at people. (-)
		I get annoyed at the slightest provocation. (-)
		I shout or scream when I'm angry. (-)
		I get upset if others change the way that I have arranged things. (-)
	N2: Confidence	I feel sad. (-)
		I think my life is a failure. (-)
		I have a dark outlook on the future. (-)
		I feel lonely. (-)
		I feel desperate. (-)

Table 5: Items of the new measure and their corresponding facets and domains *(continued)*

Domain	Facet	Item
	N3: Carefreeness	I worry a lot. (-)
		I often feel tense. (-)
		I am filled with doubts about things. (-)
		I worry about what people think of me. (-)
		I feel fearful. (-)
	N4: Mental balance	I remain calm under pressure.
		I can handle stress well.
		I face danger confidently.
		I readily overcome setbacks.
		I adapt easily to new situations.
	N5: Drive	I feel it hard to get going. (-)
		I hardly know where my life is going. (-)
		I give up easily. (-)
		I let others discourage me. (-)
		I never spend more than I can afford. (-)
	N6: Emotional robustness	I cry easily. (-)
		I get overwhelmed by emotions. (-)
		I need protection. (-)
		I am easily hurt. (-)
		I immediately feel sad when hearing of an unhappy event. (-)

Table 5: Items of the new measure and their corresponding facets and domains *(continued)*

Domain	Facet	Item
	N7: Self-attention	I need the approval of others. (-)
		I am preoccupied with myself. (-)
		I feel threatened easily. (-)
Openness to experience	O1: Creativity	I do unexpected things.
		I know that my ideas sometimes surprise people.
		I pride myself on being original.
		I ask questions that nobody else does.
		I love to think up new ways of doing things.
	O2: Wish for variety	I like to visit new places.
		I like to travel.
		I am excited by many different activities.
		I have been creative during the last year.
		I like concerts.
	O3: Open-mindedness	I am valued by my friends for my good judgment.
		I am valued by others for my objectivity.
		I know how to apply my knowledge.
		I can see different points of view.
		I come up with alternatives.

Table 5: Items of the new measure and their corresponding facets and domains *(continued)*

Domain	Facet	Item
	O4: Interest in reading	I read a lot.
		I like to read.
		I enjoy discussing books with others.
		I have read the great literary classics.
		I enjoy reading nonfiction.
	O5: Artistic interests	I appreciate all forms of art.
		I like art.
		I like poetry.
		I seldom notice the emotional aspects of paintings and pictures. (-)
		I like to visit museums.
	O6: Wish to analyze	I tend to analyze things.
		I like to speculate about things.
		I seek explanations of things.
		I love to reflect on things.
		I try to understand myself.
	O7: Willingness to learn	I want to increase my knowledge.
		I look forward to the opportunity to learn and grow.
		I find the world a very interesting place.
		I dislike learning. (-)
		I am thrilled when I learn something new.

Table 5: Items of the new measure and their corresponding facets and domains *(continued)*

Domain	Facet	Item
	O8: Sensitivity	I am open about my feelings.
		I rarely notice my emotional reactions. (-)
		I find it hard to understand why people get emotional. (-)
		I am open about myself to others.
	O9: Intellect	I learn quickly.
		I am quick to understand things.
		I can handle a lot of information.

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