The Berliner Multi-Facet Personality Inventory: An extensive measure of Big Five personality

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Abstract

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1. Introduction

Over the last decades, the Five Factor Model as well as the Big Five model have become widely accepted models for describing general attributes of personality. Often the terms are even used synonymously, which is why we will refer to the Big Five from here on. The Big Five is a hierarchical model which describes human individual differences in personality at the dispositional level: one of the most basic, universal, biologically-influenced and stable layers of human inter-individual differences in behavior, cognition and feeling (McAdams & Pals, 2006). Its hierarchical conception is relevant to acknowledge behavior from the most specific (nuances) to the most broad differences in temperament and character (dimensions), through a varying number of mid-level personality characteristics (facets). Most of the research concerning criterion validity of the Big Five inventories has focused on the covariation between the Big Five dimensions and relevant external outcomes. However, specific dispositional characteristics captured on the facet level might be of extreme utility to provide more complex descriptions of individuality and to predict life outcomes to a major extent (Lounsbury, Sundstrom, Loveland, & Gibson, 2002; Paunonen & Ashton, 2001; Ziegler et al., 2014). Unfortunately, the number and nature of the facets below the Big Five 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 or extension to an existing domain measure. While this has many theoretical advantages it also has the disadvantage of potentially limiting the search space of possible facets. In this work we aim at maximizing this search space and present a personality questionnaire which is broad at the facet level, open-access, and measurement invariant across two different cultures.

1.2. A short history of the Big Five

Francis Galton is credited as being the one who 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.

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 oblique personality 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 other dimensions within the Big Five: Agreeableness, Conscientiousness and Openness.

A large number of studies have focused on the problem of personality structure resulting in a five factor solution (Borgatta, 1964; Fiske, 1949; Norman, 1967; Tupes & Christal, 1961). Possibly the two most widely cited works relating to the foundations of the Big Five are those by Goldberg et al. (2006) and Costa and McCrae (1995). Goldberg can be seen as one of the first who extended research concerning the Big Five, while 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, and V) Openness or Intellect or Culture.

One of the most important features of the Big Five is the fact that it could be replicated in different languages. Research is available in Japanese, Vietnamese, German, Spanish, Greek, and many more (McCrae & Costa, 1997; Schmitt et al., 2007). This finding suggests that the way human beings construe personality is at some point universal and that its basic features are retained within the Big Five. Another essential characteristic relies on its hierarchical nature. The five domains are useful to retain the big picture of personality, maximize the situation consistency and reliably assess difficult subjects such as children. Nonetheless, each dimension is conceptualized as a latent construct formed by more specific narrow factors called facets, which in turn are useful to depict the impact of personality characteristics into specific behaviors and concrete life outcomes.

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

health, personality disorders, political attitudes and many more. The empirical findings linking Big Five measures to life outcomes have reinforced the concurrent validity of the test scores interpretations. At the same time, the broad nature of the domains has spurned research into the more fine-grained lower order structure of facets.

1.3. Facet Structures

There are a number of models that include a facet structure below the five broad domains. The most widely known model is the one suggested by Costa and McCrae (1995), the NEO-PI-R model. 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 different possibilities of facets forming the domains. However, there is still a degree of overlap between 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: *Altruism* and *Compliance* for Agreeableness; *Anxiety* and *Depression* for Neuroticism; *Order* and *Self-Discipline* for Conscientiousness; *Assertiveness* and *Activity* for Extraversion; 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 by 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 not intrinsically tapping at either Anxiety or Depression. The same authors asserted in a later work (Soto & John, 2016) that the Big Five domains *"can be conceptualized and assessed more broadly or more narrowly"*, either focusing in a central facet or in a set of peripheral facets, depending the research interest.

The mid-level layer between domains and facets has also been explored by DeYoung, Quilty, and Peterson (2007). Their work has focused in the biological consistency of the NEO-PI-R set of facets, thereby proposing a two factor source of variance for each facet of the inventory. In line with their proposal, Agreeableness would be composed by *Compassion* and *Politeness*; Neuroticism by *Volatility* and *Withdrawal*; Conscientiousness by *Industriousness* and *Orderliness*; Extraversion by *Enthusiasm* and *Assertiveness*; and Openness by *Intellect* and *Openness*. Both Soto and John (2009) and DeYoung et al. (2007) proposals have many points in common. Maybe the labels *Volatility* and *Withdrawal* for Neuroticism can be suspicious of a different content than *Anxiety* and *Depression*, but when inspected at the item level it is revealed that they are tapping the same components respectively (DeYoung et al. (2007); for item specification).

The nomological network commonly assumed in Big Five questionnaires is drawn from nuances through facets to domains, from more specific to more general. Relying on domains to explain and predict behavior can benefit from ease of interpretability. However, 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 life outcome 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 in 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 college grades were associated with low gregariousness, excitement seeking and order as well as high activity, openness to ideas and openness to values. Often different facets within the same domain can have effects in opposite directions, partially canceling out the predictive ability when only paying attention to the domain score. This is the case for Openness to ideas vs. Openness to fantasy, as the former is related positively to academic achievement whereas the latter is related negatively (Ziegler, Bensch, Maas 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. However, facet scores have also been shown to be related to personality disorders. Thus, the combination of a higher fidelity along with the potential clinical relevance of facet scores might open up unique advantages for clinical research.

1.4. The Big Five and Personality Disorders

Personality disorders are steadily shifting from a categorical definition into a 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). These 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 number of facets per domain on the PID-5 is limited.

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 a study by Reynolds and Clark (2001). Furthermore, the use of facets may be of extreme utility for those PD whose personality profile is less clear at the domain level. As Saulsman and Page (2004) pointed out, Schizotypal and Obsessive-Compulsive disorders are examples of PD which are not well covered by Big Five domains. A reason for it may be found in a pattern inconsistency of facets within the same dimension or in a lack of coverage for essential characteristics of the PD. For example, aberrant cognitions are essential characteristics of schizotypal disorder and are not covered by some instrument's facets like the NEO-PI-R (Samuel & Widiger, 2008; Saulsman & Page, 2004). Likewise, the expected high scores on warmth and low scores on assertiveness could mask the effects of extraversion when predicting Dependent Personality Disorder, following the theoretical correspondence between PD and Big Five facets proposed by Costa Jr. and Widiger (1994). Moreover, the PID-5 has prompted the elaboration of a number of Five Factor Model Personality Disorders (FFMPD) scales to maximize the facet coverage in relation to specific PDs (Bagby & Widiger, 2018).

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

1.5. This study

We present in this paper an instrument for personality assessment which aims to cover the need for an internationally usable, open source, and differentiated measure at the facet level. Two studies are presented, for each one inspects the factor structure of the instrument in a different sample drawn from a different culture (American vs. German). Measurement invariance across samples will be examined. Internal consistency and test-criterion

correlations will be estimated for all scores. To sum up, the aim for this research project was to provide an instrument that can be used in non-clinical but also in clinical research which emphasizes the facet level of the Big Five.

2. Methods

Two different studies are presented in this work. The first study uses a sample drawn from the USA bachelor student population. The aim was to detect and confirm a model that maximizes the facet space below the Big Five domains. Exploratory factor analysis (EFA) was used to identify the number of facets per domain. A confirmatory factor analysis (CFA) per facet was specified in order to confirm the item - facet relationship. Finally, an exploratory strucutural equation model (ESEM) was applied to test a full model in which the facets serve as indicators of the Big Five domains. 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 is a sample representative for the German speaking population of Germany, Austria and Switzerland. The aim for the second study was to replicate the structure found in study one, plus assess the degree of measurement invariance of the proposed model.

Study 1 - US-American Sample

Participants. The sample consisted of 722 American undergraduate students (59.30% male) who participated voluntarily. The mean age was 21.60 years (SD = 5.90). Students were emailed a link to a computerized assessment battery that included the IPIP items as well as several other tests not reported in this paper. The data set was randomly split into two equally sized samples. Both samples were matched in relation to missing

values, outliers and extreme values. In Sample 1 the mean age was 21.80 years (SD= 6.30), in Sample 2 the mean age was 21.50 years (SD=5.60).

Measures

Items from the 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").

The item selection was part of a different project and the procedure has been explained in detail in the appendix of a study by MacCann, Duckworth, and Roberts (2009). That study also contains part of the sample used here. However, the current data set contains more participants.

Satisfaction With Life (SWL). Measured with a 5 item composite defined in Diener, Emmons, Larsen, and Griffin (1985), answered in a 7 point Likert-type scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The items are: a)"In most ways my life is close to ideal", b) "The conditions of my life are excellent", c) "I am satisfied with my life", d) "So far I have gotten the important things in my life", and e) "If I could live my life over, I would change almost nothing". Psychometric properties have been reported excellent. (In which moment have SWLS been measured? just at the same time point than personality?)

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

SAT.

ACT.

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

2.1.3. Procedure

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

CFA and ESEM with subsample 1. To confirm the structure of facets the EFAs delivered, multiple CFAs were calculated via Mplus. In a first step, measurement models were estimated for each of the facets. To obtain balance between the facets, the items were reduced to five per facet based on item content and loading pattern. In a second step, the estimations for the measurement models on facet levels were repeated via CFA. For both steps estimators were WLSMV (Weighted Least Squares adjusted for Means and Variances). Aim was to ensure an optimal breadth and sufficient reliability. In a final model, all five domain structural models were integrated using ESEM (Asparouhov & Muthén, 2009). Marsh et al. (2010) could show that ESEM fits personality data better and results in substantially more differentiated factors than CFA. All facets were allowed 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 !WLSMV?, factor scores from the facet CFAs were used as indicators and the rotation was oblique (using Geomin). Model fit was determined based on the guide lines by Hu and Bentler (1999) as well as Beauducel and Wittmann (2005). Consequently, to consider a good fit of a proposed model, the Comparative Fit Index (CFI) should be at or over .95, the Standardized Root Mean Squared Residual (SRMR) smaller than .08 and the Root Mean Square Error of Approximation (RMSEA) smaller than .06. For the ESEM models we compared our results with the findings by Marsh et al. (2010).

Criterion validity evidence. To examine the nomological structure of the facets and domains to external constructs, correlations at the facet level were computed. We describe here a set of hypothesis prompted by other's research in the interplay between personality and the external criteria used in this work.

First, let's examine the relation of personality with satisfaction with life. At the domain level, Neuroticism and Extraversion have been noted as the most prominent predictors of satisfaction with life. Their role in mediating the hedonic balance between personality and subjective satisfaction has been hypothesized as key for this relationship (Diener, Oishi, & Lucas, 2003; Schimmack, Diener, & Oishi, 2002). Schimmack, Oishi, Furr, and Funder (2004) found that analysis at the facet level outperform the analysis at the domain level. These authors assessed personality with NEO-PI-R and IPIP-NEO and found that the facets Depression and Positive emotions / Cheerfulness were the most important predictors of the SWLS. Correlations for Depression ranged r = -57 to r = -.49, and for Positive emotions / Cheerfulness r = .51 to r = .38 (both measured with the self-report version). These two facets were the only significant predictors in a stepwise regression analysis which included all the facets from Neuroticism and Extraversion. Together they explained between 30% of the variance of self reported life satisfaction. The relation of

SWLS with facets from other domains were not inspected as the correlations at the domain level were not significant. In our instrument, the facets Confidence (N2) and Positive attitude (E4) are equivalent in content to Depression and Positive emotions / Cheerfulness of the NEO-PI-R and IPIP-NEO. We therefore hypothesize that such facets will correlate and predict satisfaction with life in a similar degree.

Regarding academic performance, Conscientiousness has been reported as the most consistent personality predictor at the domain level. In the meta-analysis by O'Connor and Paunonen (2007) the corrected correlation between academic achievement and Conscientiousness was $r = .24$. However, this relationship might not be linear according to other authors who reported inverted-U relations (Cucina & Vasilopoulos, 2005). Being the relationship between the other Big Five domains and academic achievement less clear, facet level analysis becomes important. Achievement-striving, Self-discipline and Dutifulness are the best predictors of academic performance under the Conscientiousness domain, according to the revision by O'Connor and Paunonen (2007). Its correlation coefficients range from $r = .15$ to $r = .39$, from $r = .18$ to $r = .46$, and from $r = .25$ to $r = .46$ respectively. Openness' facets yield unconclusive patterns at the domain level, as we pointed out in the introduction. Openness to ideas can be a facilitator towards better GPA, wih correlations being found $r = .22$ in Dollinger and Orf (1991) and $r = .15$ in Ziegler et al. (2010), although this finding has failed to be reproduced in some other research (Chamorro-Premuzic & Furnham, 2003; De Fruyt & Mervielde, 1996). Context dependent characteristics may be influencing this lack of replicability (Ziegler et al., 2014). In the other hand, Openness to fantasy has found to yield a negative relation to GPA $r = -.22$ for men, whereas Aesthetics yielded a similar relationship with GPA for women $r = -.19$ (De Fruyt & Mervielde, 1996). Concerning Extraversion, gregariousness has been found to correlate negatively with academic achievement, with $r = -.20$ (Chamorro-Premuzic & Furnham, 2003); activity has yielded contratictory results, being positively correlated in the De Fruyt and Mervielde (1996) analysis ($r = .26$) but negatively in the Chamorro-Premuzic and Furnham (2003) experiment $r = -.24$. Results found for the

Impulsivity and Anxiety facets of Neuroticism have been more clear, with correlation ranging from r = -.14 to r = -.26 for Impulsivity and r = -.29 for Anxiety. Agreebleness' facets have failed to yield significant correlations with GPA, although some of them may be important for certain job performance (Ziegler et al., 2014). Say something about Noftle Robins here.

Absences from school was the behavioral variable chosen to be controlled in this study.

Results

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

< Table 2 here>

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

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

Results of CFA and ESEM. All measurement models for the facets fitted well, results are summarized in *Table 3*. In this table both models with five items only and models with all items are presented with their respective model fit. The 5-item facets normally outperform the models including all items regarding model fit.

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

The ESEM of the final model with all five domains yielded an acceptable fit (Marsh et al., 2010): CFI = .87, RMSEA = .072, SRMR = .036. As it can be seen in *Table 4* nearly all facets loaded significantly on their intended domain. Some cross loadings emerged as is typical for ESEM procedures.

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

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

Regarding the academic performance criteria (GPA, SAT and ACT), the Openness facets O4 (Interest in reading), O6 (Wish to analyze) and O9 (Intellect) yield the most consistent correlations. Interestingly, O4 correlates directly with the reading subtests of SAT (r = 0.25) and ACT (r = 0.2) and shows a negligible relationship with the math (r = 0.06 / 0.08) subscales.

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

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

< Table 5 here caption="Criterion correlations" >

Study 2 – German Sample

Participants. The representative sample consisted of 387 German speakers (49.10% male) with a mean age of 45.60 years (SD = 17.50). The data was collected in a test center.

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 in appendix B.

Procedure

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

Step 2 – Testing for measurement invariance. In a next step, measurement invariance between German and US samples was examined. We followed the procedure suggested by Sass (2011) and tested configural, factorial and strong factorial invariance. The cutoffs suggested by Chen (2007) were applied to compare model fits. According to this configural measurement invariance can be assumed when the same item is associated with the same factor in each domain, while the factor loadings can differ. If the factor loadings of each item would not differ between the samples, factorial measurement invariance can be assumed. Strong factorial measurement invariance can be assumed when on top of that the

intercepts of each item are equal. The limit to factorial measurement invariance was set to 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 items per facet. Model fits can also be seen in *Table 3*. The ESEM with all five domains showed a relatively good fit to the data with CFI = .82, RMSEA = .078, SRMR = .044. *Table 6* shows the ESEM factor loadings for the German sample. All facets loaded significantly on their intended domain.

<Table 6 here >

Results of MI. For analyzing measurement invariance the latest facet model structure (with additional facets) was taken. The results are shown in Table 7. Configural measurement invariance could be shown 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 could be shown for the facets Meanness, Trust (facets of Agreeableness), Control of others, Lack of (Self-) Control, Deliberation/Caution,

Lack of Tidiness/Order (facets of Conscientiousness), Sensation Seeking, Reclusiveness, Emotionality, Humor (facets of Extraversion), Depression, Anxiety, Self-assuredness, Lethargia, Sentimentality (facets of Neuroticism), Openness to reading, Openness to arts and Need for cognition (facets of Openness).

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

<Table 7 here>

Discussion

We have presented in this work an open-access instrument for personality assessment within the Big Five framework, which showed evidences of factorial validity in two different cultures and maximized the space set of facets encompassed. With a modest number of items (202) by comparison with the most influential Big Five inventories presented in *Table 1*, we have reached to a large set of facets which mostly show a robust factorial validity in both studies, as shown in *Table 3*.

The Big Five solution has been recognized as the most replicable model for personality inventories, reaching a hallmark of consensus in personality science for the last decades. However, some researchers have pointed out that while the Big Five has repeatedely been found when fitting EFA to personality data, its replicability under CFA procedures has been more elusive (McCrae, Zonderman, Costa, Bond, & Paunonen, 1996). The constriction of the common independent cluster solution, where cross-loadings are restricted to zero, may suppose a rather strong assumption for personality trait inventories (Marsh et al., 2010). The idea of facets, or habits, being influenced by more than one domain can definitely make some sense. ESEM helps overcoming this assumption and provides a measure about how well

the Big Five solution adjusts to the data. Using this procedure, the degree of integration of our proposed set of facets to the Big Five factor solution has been solid enough according to the cut-off values proposed by Marsh et al. (2010). The number of significant cross-loadings in the ESEM models has not been large either, advocating a good discriminant validity.

The instrument covers all the "core" facets proposed by Soto and John (2009), either directly or indirectly. The Energy construct in Extraversion is literally covered by a three-item facet in our instrument, whereas the Assertiveness construct has been tapped by items belonging to the Wish for affiliation, Communicativeness and Conviviality facets. Altruism is directly reflected in a five-item facet, while the Compliance construct is reflected by our Good faith facet. The Order and Self-discipline constructs proposed by Soto and John (2009) are mirrored by dedicated facets in our instrument. The Anxiety and Depression constructs are mirrored by the facets Mental balance and Emotional robustness, respectively. For the Openess dimension, the Aesthetic contruct is covered by our facet Artistic interest, while the Ideas construct has been reflected by both the Open-mindedness and the Wish to analyze facets. The two-per-facet components proposed by DeYoung et al. (2007) were also being tapped by the set of facets in our inventory.

The instrument covers most of facets proposed by the most influential Big Five measures as seen in *Table 1.* The most salient differences are related to the HEXACO model, which entails a six factor solution with a slightly different theoretical conceptualization (Lee & Ashton, 2006). Most notably

Although these facets are not being covered directly in our inventory, components of facets from distinct domains in our model retain a glimpse of the missing facets. This underlies the importance of allowing cross-loadings for trait personality data. Let's use the example of *Patience*, a facet proposed in the HEXACO model for the Agreeableness domain which is not covered in our instrument, nor in the other three Big Five inventories which have been revised. Although patience, there is a notion of a patient trait within the

Self-discipline facet in the Conscientiousness domain, specially with items such as “I rush into things” or “I act impulsively when something is bothering me” (See appendix A). In fact, Self-discipline has important cross-loadings with Agreeableness in both samples (λ = .256 in the USA sample and λ = .341 in the german sample).

In addition we included even more facets.

In addition, evidences for external criteria validity were attained.

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.

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

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Table captions