¹ The Berliner Multi-Facet Personality Inventory: An extensive measure of Big Five

² personality

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13   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 (D. P. 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; S. V. 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 P. T. 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 (**???**; 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 B. W. 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

⁹⁴ work performance, health, personality disorders, political attitudes and many more. The

⁹⁵ empirical findings linking Big Five measures to life outcomes have reinforced the concurrent

⁹⁶ validity of the test scores interpretations. At the same time, the broad nature of the domains

⁹⁷ has spurred research into the more fine-grained lower order structure of facets.

⁹⁸ **1.3. Facet Structures**

⁹⁹ There are a number of models that include a facet structure below the five broad

¹⁰⁰ domains. The most widely known model is the one suggested by P. T. Costa and McCrae

¹⁰¹ (1995), the NEO-PI-R model. Other popular models have been suggested for the Big Five

¹⁰² Inventory 2 (BFI-2; Christopher J Soto & John, 2016), the IPIP (Goldberg et al., 2006), and

¹⁰³ the HEXACO model (K. Lee & Ashton, 2016), which assumes six broad domains. *Table 1*

¹⁰⁴ gives an overview of these different models listing their facets per domain as well as some

¹⁰⁵ information regarding their psychometric properties.

¹⁰⁶ < Table 1 >

¹⁰⁷ As shown in *Table 1*, there are different possibilities of facets forming the domains.

¹⁰⁸ However, there is still a degree of overlap between the facets covered by the different

¹⁰⁹ instruments. Christopher J. Soto and John (2009) inspected the convergences between the

¹¹⁰ NEO-PI-R and the first version of the BFI, suggesting that two constructs per domain were

¹¹¹ measured at the facet level by both inventories. The constructs defined by Christopher J.

¹¹² Soto and John (2009) were: *Altruism* and *Compliance* for Agreeableness; *Anxiety* and

¹¹³ *Depression* for Neuroticism; *Order* and *Self-Discipline* for Conscientiousness; *Assertiveness*

¹¹⁴ and *Activity* for Extraversion; and *Aesthetics* and *Ideas* for Openness. The convergence holds

¹¹⁵ for the four instruments listed in *Table 1*, as these ten constructs are covered within the

¹¹⁶ facets for every instrument. Some of the constructs are explicitly covered at the facet level

117 (e.g. Anxiety); meanwhile others are mainly covered by the four instruments, although

118 sometimes implicitly (e.g. Liveliness in HEXACO resembles the "core" construct Activity,

119 present in all other instruments). The reverse is not always true, not every facet within the

120 four instruments is covered by the constructs proposed by Christopher J. Soto and John

121 (2009). As an example we find Self-Consciousness, a Neuroticism facet defined by the

122 NEO-PI-R and the IPIP-NEO-120, which is not intrinsically tapping at either Anxiety or

123 Depression. The same authors asserted in a later work (Christopher J Soto & John, 2016)

124 that the Big Five domains *"can be conceptualized and assessed more broadly or more*

125 *narrowly"*, either focusing in a central facet or in a set of peripheral facets, depending the

126 research interest.

127   The mid-level layer between domains and facets has also been explored by DeYoung,

128 Quilty, and Peterson (2007). Their work has focused in the biological consistency of the

129 NEO-PI-R set of facets, thereby proposing a two factor source of variance for each facet of

130 the inventory. In line with their proposal, Agreeableness would be composed by *Compassion*

131 and *Politeness*; Neuroticism by *Volatility* and *Withdrawal*; Conscientiousness by

132 *Industriousness* and *Orderliness*; Extraversion by *Enthusiasm* and *Assertiveness*; and

133 Openness by *Intellect* and *Openness*. Both Christopher J. Soto and John (2009) and

134 DeYoung et al. (2007) proposals have many points in common. Maybe the labels *Volatility*

135 and *Withdrawal* for Neuroticism can be suspicious of a different content than *Anxiety* and

136 *Depression*, but when inspected at the item level it is revealed that they are tapping the

137 same components respectively (DeYoung et al. (2007); for item specification).

138   The nomological network commonly assumed in Big Five questionnaires is drawn from

139 nuances through facets to domains, from more specific to more general. Relying on domains

140 to explain and predict behavior can benefit from ease of interpretability. However,

141 predictions for specific contexts can be enhanced if a more specific set of traits is used. On

142 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.

Personality measured at the facet level has found to be a strong predictor of a large number of outcomes. Satisfaction with life (SWL) is one of them. Neuroticism and Extraversion were recognised as the most important personality dimensions in the prediction of subjective satisfaction (Diener, Oishi, & Lucas, 2003; Schimmack, Diener, & Oishi, 2002). Lately, Schimmack, Oishi, Furr, and Funder (2004) observed that the analysis at the facet level outperform the analysis at the domain level. They observed that *Depression* and *Positive Emotions / Cheerfulness* explained SWL above and beyond the dimensions they belong to, reaching to a 30% of explained variability of SWL. Correlations in the Schimmack et al. (2004) study ranged in a longitudinal design from $r = -.57$ to $r = -.49$ for the first and from $r = .51$ to $r = .38$ for the second and third.

Another relevant outcome that has shown to be best predicted with personality at the facet level is academic achievement. The relation of Conscientiousness with academic performance has gained a stable empirical evidence, with correlations ranging from $r = .20$ to $r = .45$ depending in sample specifity (Chamorro-Premuzic & Furnham, 2003; De Fruyt & Mervielde, 1996; Lievens, Coetsier, De Fruyt, & De Maeseneer, 2002; Noftle & Robins, 2007; O'Connor & Paunonen, 2007; S. V. Paunonen & Ashton, 2001; Poropat, 2009, 2014; D. Watson & Watson, 2002). De Fruyt and Mervielde (1996) hypothesized that volitional facets of Conscientiousness would be more proned to exhibit strong relations with academic achievement. In this line, there is a collection of research which points at relations of GPA scores with facets such as *Achievement-striving* (Chamorro-Premuzic & Furnham, 2003;

O'Connor & Paunonen, 2007 r ranging from .15 to .39; D. Watson & Watson, 2002 $r = .39$)

or *Work drive* (Lounsbury et al., 2002, $r = .12$). Nonetheless, also other Conscientiousness

facets more related to duties or moral driveness have been found to predict significantly GPA

scores, like *Self-discipline* (O'Connor & Paunonen, 2007, r ranging from .18 to .25; D.

Watson & Watson, 2002, $r = .36$) or *Dutifulness* (Chamorro-Premuzic & Furnham, 2003;

O'Connor & Paunonen, 2007, r ranging from .25 to .38). The relation of academic

achievement with Openness has been more variant. Following the categories proposed by

Costa & McCrae, students which showed both high Conscientiousness and high Openness

would be considered "good students". Moreover, those who score high in Openness but not

in Conscientiousness were labelled "dreamers" and their performance in academic test is less

stable. Some studies found a significant relation between the Openness dimension and

academic achievement (Lievens et al., 2002, $r = .09$; D. Watson & Watson, 2002, $r = .18$),

while some others failed to replicate this findings (Chamorro-Premuzic & Furnham, 2003; S.

V. Paunonen & Ashton, 2001, $r = -.04$). Is within this dimension were facet level analysis

may be hugely useful. (**???**) found that the Openness facet of *Understanding* correlates with

academic achievement with a $r = .23$. Noftle and Robins (2007) identified a set of

NEO-PI-R and HEXACO's Openness facets which predicted academic achievement (the

HEXACO facets of *Aesthetic*, *Inquisitiveness*, *Creativity* and *Unconventionality*, plus the

NEO-PI-R facets of *Fantasy*, *Aesthetics*, *Feelings* and *Ideas*). Oppositely, (**???**) found that

Openness to ideas was related positively with work performance, while *Openness to fantasy*

was related negatively, potentially masking the overall effect of Opennes over the working

performance criterion. In this study we aim to get deep into the research question of which

facets are involved in scholastic achievement, using a widely facetted inventory. Moreover,

narrow level analysis seems to improve the predicitive power of personality on academic

performance, adding about 10% of explained variance (Lounsbury, Steel, Loveland, &

Gibson, 2004; O'Connor & Paunonen, 2007; Ziegler, Danay, Schölmerich, & Bühner, 2010).

Likewise, personality has proven to be a powerful predictor of laboral and educational

abseentism (Chamorro-Premuzic & Furnham, 2003; Judge, Martocchio, & Thoresen, 1997; Salgado, 2002). Research has highlighted the predictive power of personality test over the so-called integrity test when predicting absences (Ones, Viswesvaran, & Schmidt, 2003). Again, most research has focused on the dimensional level, although some researchers suggested that personality assessed at a narrower level would improve the predictive ability of the models (Lounsbury et al., 2004; Salgado, 2002). Nonetheless, few studies have explored this relationship to our knowledge, being Lounsbury et al. (2004) and Judge et al. (1997) the most prominent. Judge et al. (1997) dreported no predictive gain when examining personality at the facet level for the NEO-PI-R composites of Extraversion and Conscientiousness, whereas Lounsbury et al. (2004) found a modest predictive gain of *Work drive* over the Big Five dimensions. Therefore, and despite the conceptual expectation of facets maximizing the predictive ability of personality on abseentism, evidence has manifested in favour of a dimension level analysis. However, it can be arguable that more research needs to be done in this area, preferably using personality inventories which are broad at the facet level.

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

²²¹ were moving along, named traits. In fact, the new version of the Diagnostic and Statistical

²²² Manual of mental disorders, DSM-V, now proposes two different ways of assessing

²²³ personality disorders: 1) A descriptive model of personality disorders in section II which

²²⁴ mimics the former model of assessing personality disorders and; 2) A novel trait model that

²²⁵ follows research on the personality scientific domain (In section III), which conceptualizes

²²⁶ personality disorders as extreme tendencies located in the continuum of the Big Five domains

²²⁷ and facets (American Psychiatric Association, 2013; T. A. Widiger & Mullins-Sweatt, 2009)

²²⁸   This paradigm shift in clinical assessment of personality has led to the construction of

²²⁹ the Personality Disorder Inventory (PID-5; R. F. Krueger, Derringer, Markon, Watson, &

²³⁰ Skodol, 2012), a 25-facet and five-dimension self-report inventory, with an informant-report

²³¹ version (K. E. Markon, Quilty, Bagby, & Krueger, 2013). These five dimensions mirror the

²³² Big Five domains, although with a focus on the maladaptative end of the continuum,: I)

²³³ Detachment (Big Five's Introversion), II) Antagonism (absence of Big Five's Agreeableness),

²³⁴ III) Disinhibition (absence of Big Five's Conscientiousness), IV) Negative affect (Big Five's

²³⁵ Neuroticism) and V) Psychoticism (Absence of Big Five's Openness). The PID-5 has shown

²³⁶ satisfying evidences of criterion validity (…summary). However, the number of facets per

²³⁷ domain on the PID-5 is limited.

²³⁸   In line with what has been stated previously for academic achievement, the

²³⁹ examination of facets may result in an enhancement of the specificity of assessment when

²⁴⁰ looking at the nature of PDs (L. A. Clark, 2005; Samuel & Widiger, 2008). This

²⁴¹ improvement of specificity resulted in a predictive gain ranging from 3% to 16% when

²⁴² comparing facets to domains predicting PD in a study by Reynolds and Clark (2001).

²⁴³ Furthermore, the use of facets may be of extreme utility for those PD whose personality

²⁴⁴ profile is less clear at the domain level. As Saulsman and Page (2004) pointed out,

²⁴⁵ Schizotypal and Obsessive-Compulsive disorders are examples of PD which are not well

²⁴⁶ 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 (R. M. 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.

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). In the first study we develop the instrument by confirming a factorial structure found after fitting an exploratory factor analysis. Reliability indices are provided for the facets. Furthermore, we use the found facets to predict external outcomes and thereby provide evidences of criterion validity. We aim to test the following hypothesis, designed to replicate previous findings:

- H1. SWL will be best predicted by the composites of Extraversion and Neuroticism.
    - H1.1. Adding the facets will significantly improve the predictions of personality

on SWL.

- – H1.2. Particularly the facets *Confidence* (N2) and *Positive attitude* (E4) will behave similarly to those reported by Schimmack et al. (2004).

- • H2. Conscientiousness will be the strongest dimension when predicting academic achievement.

  - – H2.1. Openness will be related positively but moderately to academic achievement.

  - – H2.2. Facets will add about 10% of additional explained variance to dimensions when predicting academic achievement

- • H3. Facets will improve the predictive power of dimensions when predicting school abseentism.

Furthermore, we aim to provide evidences on the research questions of which facets predominantly correlate with academic achievement and school abseentism. Measurement invariance across samples will be examined in the second study. 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.

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. 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

₂₉₆ measured (Marsh et al., 2010). Finally, reliability measures for the facets and test-criterion

₂₉₇ correlations will be computed to achieve evidences of reliability and criterion validity.

₂₉₈ The second sample is a sample representative for the German speaking population of

₂₉₉ Germany, Austria and Switzerland. The aim for the second study was to replicate the

₃₀₀ structure found in study one, plus assess the degree of measurement invariance of the

₃₀₁ proposed model.

Study 1 - US-American Sample

₃₀₃ **Participants.** The sample consisted of 722 American undergraduate students

₃₀₄ (59.30% male) who participated voluntarily. The mean age was 21.60 years (SD = 5.90).

₃₀₅ Students were emailed a link to a computerized assessment battery that included the IPIP

₃₀₆ items as well as several other tests not reported in this paper. The data set was randomly

₃₀₇ split into two equally sized samples. Both samples were matched in relation to missing

₃₀₈ values, outliers and extreme values. In Sample 1 the mean age was 21.80 years (SD= 6.30),

₃₀₉ in Sample 2 the mean age was 21.50 years (SD=5.60).

Measures

₃₁₁ **Items from the International Personality Item Pool (IPIP).** Altogether, 525

₃₁₂ items from the *International Personality Item Pool* (IPIP) were used to measure

₃₁₃ Neuroticism, Extraversion, Openness (to experience), Agreeableness and Conscientiousness.

₃₁₄ The IPIP is an open source database of personality items, which was launched in 1996, and

₃₁₅ contains over 2000 items (Goldberg et al., 2006). Participants were asked to rate themselves

₃₁₆ on typical behaviors or reactions on a 5-point Likert scale, ranging from 1 ("Not all like me")

₃₁₇ to 5 ("Very much like me").

318 The item selection was part of a different project and the procedure has been explained

319 in detail in the appendix of a study by MacCann, Duckworth, and Roberts (2009). That

320 study also contains part of the sample used here. However, the current data set contains

321 more participants.

322 **Satisfaction With Life (SWL).** Measured with a 5 item composite defined in

323 Diener, Emmons, Larsen, and Griffin (1985), answered in a 7 point Likert-type scale ranging

324 from 1 (*strongly disagree*) to 7 (*strongly agree*). The items are: a)"In most ways my life is

325 close to ideal", b) "The conditions of my life are excellent", c) "I am satisfied with my life",

326 d) "So far I have gotten the important things in my life", and e) "If I could live my life over,

327 I would change almost nothing". Psychometric properties have been reported excellent. (In

328 which moment have SWLS been measured? just at the same time point than personality?)

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

330 **SAT.**

331 **ACT.**

332 **Absences from class.** As a behavioral measure absence from class was asked to

333 report from subjects. ABS2 ABS4 what are the differences?

334 **2.1.3. Procedure**

335 **EFA with subsample 1.** To determine the number of possible facets per domain

336 Velicer (1976) Minimum Average Partial (MAP) method and Horn (1965) parallel analysis

337 (PA) were employed for every domain. Based on these results an Exploratory Factor

338 Analysis (EFA) was calculated for each domain via Mplus using a geomin rotation (Quelle)

339 and a Maximum Likelihood estimator (ML). The decision for the preferred number of facets

340 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 estimator used was 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).

Reliability

Chronbach's α and McDonald's ω will be calculated for each facet to provide measures of internal consistency.

Criterion validity evidence. To examine the nomological structure of the facets and domains to external constructs, a set of linear models and correlations were fitted. We describe in this section the methods used to test the set of hypothesis described in the introduction.

To explore H1 we fitted a linear model that included the Big Five dimensions as predictors and SWL as citerion. To explore H1.1. we fitted a stepwise regression including the significant dimensions at the first and their related facets in the second step. H1.2. will be inspected adding N2 and E4 to the second step instead of the full set of facets.

H2 and H2.1. will be tested with a linear regression in which Conscientiousness and Openness will predict academic achievement. A stepwise regression will be used to test H2.2. Conscientiousness and Openness will be the first set of predictors and their respective facets will be entered in a second step, changes in R^2 will be inspected.

H3 will also be tested with a stepwise regression in which the Big Five dimensions will be first entered and then the full set of facets.

The research questions will be commented by looking at which facets best predict academic achievement and scholastic absences.

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")>

Reliability.   Reliabilities for the 5 item facets were calculated with α and ω estimates.

Agreeableness showed a mean α of 0.68, and a mean ω of 0.69. Conscientiousness' mean $\alpha =$

0.68, and mean $\omega = 0.70$. Openness' mean $\alpha = 0.76$, and mean $\omega = 0.77$. Neuroticism mean

$\alpha = 0.68$, and mean $\omega = 0.69$. TExtraversion's mean $\alpha = 0.72$, and mean $\omega = 0.74$.

Criterion validity evidence.   Our first hypothesis concerning external criteria

involved *Confidence* (N2) and *Positive attitude* (E4), as the most important predictors of

SWL. Our results, in line with Schimmack et al. (2004), showed that both facets were the

most salient predictors of the factor in a stepwise regresssion, and that they explained 0.34%

430   of the factor. The final model reached with the stepwise procedure explained 0.41% of the

431   factor variance. N2 and E4 outperformed Neuroticism and Extraversion, who failed to be

432   significant predictors in a stepwise model which included these four independent variables.

433   Our second hypothesis was set to replicate the findings of the meta-analysis by

434   O'Connor and Paunonen (2007) with our instrument. In the mentioned study

435   Conscientiousness showed the higher correlations with school grades with a corrected $\rho = .24$,

436   and the facets *Achievement striving*, *Self-discipline* and *Dutifulnes* were the most important

437   predictors at a narrower level. Our results are in line with those reported by O'Connor and

438   Paunonen (2007). Conscientiousness correlated $r = 0.23$ with high school grades. At the

439   facet level, C2 correlated $r = 0.12$, C3 $r = 0.13$ and C6 $r = 0.16$ with high school grades.

440   On the other hand, Openness $r = 0.15$ and Agreebleness $r = 0.20$ at the dimension level;

441   and *Goal orientation* (C5) $r = 0.22$ at the facet level also showed high correlations with

442   grades, a result not found in O'Connor and Paunonen (2007).

443   The fourth hypothesis involves *Open mindedness* (O3) as an Opennesss facilitator

444   towards achieving higher grades. We have found a correlation of $r = 0.14$ between this facet

445   and high school grades, in line with the findings of Ziegler et al. (2010). Furthermore, we

446   expected some inverse correlations between the facets of Openness, and as a result a near

447   zero correlation with the dimension. We haven't found any Openness facet with a significant

448   inverse correlation with high school grades, and as indicated previously our results don't

449   support a zero correlation of the dimension with high school grades.

450   Another relevant outcome that has shown to be best predicted with personality at the

451   facet level is academic achievement. The relation of Conscientiousness with school grades has

452   gained a stable empirical evidence, widely inspected in the meta-analysis by O'Connor and

453   Paunonen (2007) were the mean ρ was .24. At the facet level, O'Connor and Paunonen

454   (2007) found that *Achievement-striving*, *Self-discipline* and *Dutifulness* were the best

455   predictors of academic performance, ranging from $r = .15$ to $r = .39$, from $r = .18$ to $r =$

.46, and from $r = .25$ to $r = .46$ respectively. In the inventory presented here, the facets

Persistence (C2), *Self-discipline* (C3) and *Carefulnes* (C6) are the most related with the

previous. Our second hypothesis would be to replicate this findings. Openness is also

supposed to play an important role in predicting academic achievement, however evidence

has been elusive at the dimension level (Ziegler et al., 2010). Openness to ideas has been

found to 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). We expect to find similar

correlations with *Open mindedness* (O3) in our third hypothesis. Often different facets

within the same domain can have effects in opposite directions, partially canceling out the

predictive ability of the dimensions. This could be the case of Openness to experience, were

facet-level analysis can be unveiling. 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). In our case we expect that

Creativity (O1) yield negative correlations with GPA for both sexes, and the overall effect of

Opennes on academic achievement being nearly zero, this will be our fourth hypothesis.

The second to sixth hypothesis involves academic performance as criterion variable.
The second and third hypothesis will be explored via inspection of the correlation matrix
with the Big Five dimensions. The fourth hypothesis will be explored by means of a stepwise
regression were all the Conscientiousness facets will form the initial set of predictors. The
fifth hypothesis will be explored with a simple regression of O3 on high school grades. The
sixth hypothesis will be explored by inspecting the correlation of the facets forming
Openness with academic achievement.

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

₅₀₃   **Participants.**   The representative sample consisted of 387 German speakers (49.10%

₅₀₄   male) with a mean age of 45.60 years (SD = 17.50). The data was collected in a test center.

₅₀₅   **Measures.**   The five items per facet derived from Study 1 were translated and

₅₀₆   back-translated by bilingual experts, creating a German version of the measure used there.

₅₀₇   The translated items can be found in appendix B.

₅₀₈   **Procedure**

₅₀₉   **Step 1 − Examining the structure.**   To check the facet structure Study 1

₅₁₀   delivered, multiple confirmatory factor analyses were calculated via Mplus following an

₅₁₁   analogue procedure to Study 1. First, measurement models were estimated for all facets,

₅₁₂   using WLSMV as the estimator. Model fit was determined based on the guide lines

₅₁₃   mentioned above. In a final model, all five domain structural models were integrated using

₅₁₄   ESEM.

₅₁₅   **Step 2 − Testing for measurement invariance.**   In a next step, measurement

₅₁₆   invariance between German and US samples was examined. We followed the procedure

₅₁₇   suggested by Sass (2011) and tested configural, factorial and strong factorial invariance. The

₅₁₈   cutoffs suggested by Chen (2007) were applied to compare model fits. According to this

₅₁₉   configural measurement invariance can be assumed when the same item is associated with

₅₂₀   the same factor in each domain, while the factor loadings can differ. If the factor loadings of

₅₂₁   each item would not differ between the samples, factorial measurement invariance can be

₅₂₂   assumed. Strong factorial measurement invariance can be assumed when on top of that the

₅₂₃   intercepts of each item are equal. The limit to factorial measurement invariance was set to Δ

₅₂₄   CFI < .01, Δ RMSEA < .015 and Δ SRMR < .03, at which the limit to strong factorial

₅₂₅   measurement invariance was set to Δ CFI < .01, Δ RMSEA < .015, Δ SRMR < .01 as

₅₂₆   suggested by 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.

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

₅₅₁   **Discussion**

₅₅₂   We have presented in this work an open-access instrument for personality assessment

₅₅₃ within the Big Five framework, which showed evidences of factorial validity in two different

₅₅₄ cultures and maximized the space set of facets encompassed. With a modest number of

₅₅₅ items (202) by comparison with the most influential Big Five inventories presented in *Table*

₅₅₆ *1*, we have reached to a large set of facets which mostly show a robust factorial validity in

₅₅₇ both studies, as shown in *Table 3*.

₅₅₈   The Big Five solution has been recognized as the most replicable model for personality

₅₅₉ inventories, reaching a hallmark of consensus in personality science for the last decades.

₅₆₀ However, some researchers have pointed out that while the Big Five has repeatedly been

₅₆₁ found when fitting EFA to personality data, its replicability under CFA procedures has been

₅₆₂ more elusive (R. R. McCrae, Zonderman, Costa, Bond, & Paunonen, 1996). The constriction

₅₆₃ of the common independent cluster solution, where cross-loadings are restricted to zero, may

₅₆₄ suppose a rather strong assumption for personality trait inventories (Marsh et al., 2010).

₅₆₅ The idea of facets, or habits, being influenced by more than one domain can definitely make

₅₆₆ some sense. ESEM helps overcoming this assumption and provides a measure about how well

₅₆₇ the Big Five solution adjusts to the data. Using this procedure, the degree of integration of

₅₆₈ our proposed set of facets to the Big Five factor solution has been solid enough according to

₅₆₉ the cut-off values proposed by Marsh et al. (2010). The number of significant cross-loadings

₅₇₀ in the ESEM models has not been large either, advocating a good discriminant validity.

₅₇₁   The instrument presented in this work covers all the "core" facets proposed by

₅₇₂ Christopher J. Soto and John (2009), either directly or indirectly. The *Energy* construct in

₅₇₃ Extraversion is literally covered by a three-item facet in our instrument, whereas the

₅₇₄ *Assertiveness* construct has been tapped by items belonging to the *Wish for affiliation*,

₅₇₅ *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 Christopher J. 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 (K. 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 ($\lambda =$ .256 in the USA sample and $\lambda = .341$ 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

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

602 predictive validity promising.

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

604 society and results may not be generalized.

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

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

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

608 specific behaviors and facets become richer.

609   Remove this page. This is used to include the tables' references into the bibliography.

610   Brick and Lewis (2014); Gaughan, Miller, and Lynam (2012); Leone, Chirumbolo, and

611 Desimoni (2012); Mcabee, Oswald, and Connelly (2014); Gaughan, Miller, Pryor, and Lynam

612 (2009); Noftle and Shaver (2006); R. M. Bagby, Taylor, and Parker (1994); Schimmack, Furr,

613 and Funder (1999); Wakabayashi, Baron-Cohen, and Wheelwright (2006); Shaver and

614 Brennan (1992); Ruiz, Pincus, and Dickinson (2003); Mccrae, Kurtz, Yamagata, and

615 Terracciano (2011); Rosander, Bäckström, and Stenberg (2011); K. K. McAdams and

616 Donnellan (2009); Siddiqui (2011); Hagger-Johnson and Whiteman (2007)

617   Ziegler et al. (2014)

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849 **Table captions**