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

94 health, personality disorders, political attitudes and many more. The empirical findings

95 linking Big Five measures to life outcomes have reinforced the concurrent validity of the test

96 scores interpretations. At the same time, the broad nature of the domains has spurned

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

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; Soto & John, 2016), the IPIP (Goldberg et al., 2006), and the HEXACO

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

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

105 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. C. J. Soto and John (2009) inspected the convergences between the NEO-PI-R

110 and the first version of the BFI, suggesting that two constructs per domain were measured at

111 the facet level by both inventories. The constructs defined by C. J. Soto and John (2009)

112 were: *Altruism* and *Compliance* for Agreeableness; *Anxiety* and *Depression* for Neuroticism;

113 *Order* and *Self-Discipline* for Conscientiousness; *Assertiveness* and *Activity* for Extraversion;

114 and *Aesthetics* and *Ideas* for Openness. The convergence holds for the four instruments

115 listed in *Table 1*, as these ten constructs are covered within the facets for every instrument.

116 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 C. J. 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 C. J. 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.

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; Paunonen & Ashton, 2001; Poropat, 2009, 2014; 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; Watson & Watson, 2002, $r = .39$) or

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

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

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

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

173 & Paunonen, 2007, r ranging from .25 to .38). The relation of academic achievement with

174 Openness has been more variant. Following the categories proposed by Costa & McCrae,

175 students which showed both high Conscientiousness and high Openness would be considered

176 "good students". Moreover, those who score high in Openness but not in Conscientiousness

177 were labelled "dreamers" and their performance in academic test is less stable. Some studies

178 found a significant relation between the Openness dimension and academic achievement

179 (Lievens et al., 2002, $r = .09$; Watson & Watson, 2002, $r = .18$), while some others failed to

180 replicate this findings (Chamorro-Premuzic & Furnham, 2003; Paunonen & Ashton, 2001, r

181 $= -.04$). Is within this dimension were facet level analysis may be hugely useful. Paunonen

182 and Ashton (2001) found that the Openness facet of *Understanding* correlates with academic

183 achievement with a $r = .23$. Noftle and Robins (2007) identified a set of NEO-PI-R and

184 HEXACO's Openness facets which predicted academic achievement (the HEXACO facets of

185 *Aesthetic*, *Inquisitiveness*, *Creativity* and *Unconventionality*, plus the NEO-PI-R facets of

186 *Fantasy*, *Aesthetics*, *Feelings* and *Ideas*). Oppositely, O. P. John et al. (2014) found that

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

236 domain on the PID-5 is limited.

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

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

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

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

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

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

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

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

245 covered by Big Five domains. A reason for it may be found in a pattern inconsistency of

246 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
structural 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). Finally, reliability measures for the facets and test-criterion

₂₉₆ correlations will be computed to achieve evidences of reliability and criterion validity.

₂₉₇ The second sample is a sample representative for the German speaking population of
₂₉₈ Germany, Austria and Switzerland. The aim for the second study was to replicate the
₂₉₉ structure found in study one, plus assess the degree of measurement invariance of the
₃₀₀ proposed model.

Study 1 - US-American Sample

₃₀₂ **Participants.** The sample consisted of 722 American undergraduate students
₃₀₃ (59.30% male) who participated voluntarily. The mean age was 21.60 years (SD = 5.90).
₃₀₄ Students were emailed a link to a computerized assessment battery that included the IPIP
₃₀₅ items as well as several other tests not reported in this paper. The data set was randomly
₃₀₆ split into two equally sized samples. Both samples were matched in relation to missing
₃₀₇ values, outliers and extreme values. In Sample 1 the mean age was 21.80 years (SD= 6.30),
₃₀₈ in Sample 2 the mean age was 21.50 years (SD=5.60).

Measures

₃₁₀ **Items from the International Personality Item Pool (IPIP).** Altogether, 525
₃₁₁ items from the *International Personality Item Pool* (IPIP) were used to measure
₃₁₂ Neuroticism, Extraversion, Openness (to experience), Agreeableness and Conscientiousness.
₃₁₃ The IPIP is an open source database of personality items, which was launched in 1996, and
₃₁₄ contains over 2000 items (Goldberg et al., 2006). Participants were asked to rate themselves
₃₁₅ on typical behaviors or reactions on a 5-point Likert scale, ranging from 1 ("Not all like me")
₃₁₆ to 5 ("Very much like me").

₃₁₇ The item selection was part of a different project and the procedure has been explained
₃₁₈ in detail in the appendix of a study by MacCann, Duckworth, and Roberts (2009). That

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

320 more participants.

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

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

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

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

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

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

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

328   **GPA.**   Grade Point Averages measured in high school, university, and in cc (?).

329   **SAT.**

330   **ACT.**

331   **Absences from class.**   As a behavioral measure, absences from school attendance

332 was asked to be reported. Absences were log transformed prior to be analyzed, following

333 Lounsbury et al. (2004). 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

341 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.

367 **Criterion validity evidence.**   To examine the nomological structure of the facets

368 and domains to external constructs, a set of linear models and correlations were fitted. We

369 describe in this section the methods used to test the set of hypothesis described in the

370 introduction.

371 To explore H1 we explored the correlation matrix between Big Five dimensions and

372 SWL. To explore H1.1. we fitted a two-step regression including the full set of dimensions in

373 the first step and a selection of facets following a stepwise procedure in the second step. H1.2.

374 will be inspected adding only N2 and E4 to the second step instead of the full set of facets.

375 H2 and H2.1. will be tested by examining the correlation matrix of Conscientiousness

376 and Openness with academic achievement. A stepwise regression will be used to test H2.2.

377 The dimensions will be the first set of predictors and the facets will be entered in a second

378 step, changes in R^2 will be inspected. A final model with the significant predictors will be

379 fitted afterwards.

380 H3 will also be tested with a hierarchical regression in which the Big Five dimensions

381 will be first entered and then a set of facets previously selected by stepwise regression from

382 the full set.

383 The research questions will be commented by looking at which facets best predict

384 academic achievement and scholastic absences.

385 **Results**

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

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

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

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

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

391   < Table 2 here>

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

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

394   were named *Appreciation*, *Integrity*, *Low competitiveness*, *Readiness to give feedback*, *Search*

395   *for support*, *Good faith*, *Genuineness* and *Altruism*.

396   Conscientiousness consists of nine facets after one facet with item factor loadings less

397   than .30 was excluded, they are: *Dominance*, *Persistence*, *Self-discipline*, *Task planning*,

398   *Goal orientation*, *Carefulness*, *Orderliness*, *Wish to work* (to capacity) and *Productivity*.

399   Extraversion is formed by nine facets. A new facet (*Energy*) was added in order to tap

400   better the physical component of Extraversion, which was missing in the eight facet solution.

401   The facets are *Sociability*, *Readiness to take risks*, *Wish for affiliation*, *Positive attitude*,

402   *Forcefulness*, *Communicativeness*, *Humor*, *Conviviality* and *Energy*.

403   Neuroticism (interpreted here as emotional stability) consists of seven facets. One facet

404   was dropped due to poor interpretability, and was therefore not included in the subsequent

405   analyses. The final set of facets are named *Equanimity*, *Confidence*, *Carefreeness*, *Mental*

406   *balance*, *Drive*, *Emotional robustness* and *Self-attention*.

407   Openness to experience comprises nine facets. One facet was identified as a method

408   factor and eliminated, because it solely contained negatively formulated items and no

409   coherent underlying trait could be identified. Furthermore another facet (*Intellect*) was

410   added, because the remaining facets lacked an intellectual content. The facets of Openness

411   are named *Creativity*, *Wish for variety*, *Open-mindedness*, *Interest in reading*, *Artistic*

412   *interests*, *Wish to analyze*, *Willingness to learn*, *Sensitivity* and *Intellect*.

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

414   **Results of CFA and ESEM.**   All measurement models for the facets fitted well,

415   results are summarized in *Table 3*. In this table both models with five items only and models

416   with all items are presented with their respective model fit. The 5-item facets normally

417   outperform the models including all items regarding model fit.

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

419   The ESEM of the final model with all five domains yielded an acceptable fit (Marsh et

420   al., 2010): CFI = .87, RMSEA = .072, SRMR = .036. As it can be seen in *Table 4* nearly all

421   facets loaded significantly on their intended domain. Some cross loadings emerged as is

422   typical for ESEM procedures.

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

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

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

426   0.68, and mean $\omega = 0.70$. Openness' mean $\alpha = 0.76$, and mean $\omega = 0.77$. Neuroticism mean

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

428   **Criterion validity evidence.**   Our first set of hypothesis tested how personality

429   was related to SWL. Extraversion ($r = 0.33$) and Neuroticism ($r = 0.40$) were the

430   dimensions with higher correlations with SWL. In H1.1, the model which included the facets

431   outperformed the dimension model ($F = 17.89$, p < 0.001). The model resulted in a

432   predictive gain of $\Delta R^2 = 0.17$, with an adjusted R^2 for the full model of 0.38. Adding N2

433   and E4 result in a predictive gain of $\Delta R^2 = 0.12$.

Our second set of hypothesis involves predictions to academic achievement. Conscientiousness correlated with academic achievement with $r = 0.24$, being the strongest correlation of all the set of dimensions. Openness correlated $r = 0.17$ with the criterion. For H2.2, the model which included the facets again outperformed the dimensional model ($F = 5.83$, p < 0.001). The final model consisted of *Intellect* (O9), *Willingness to learn* (O7), *Interest in reading* (O4), *Emotional robustness* (N6), *Positive attitude* (E4), *Sociability* (E1), *Productivity* (C9), *Goal orientation* (C5), *Dominance* (C1), *Genuineness* (A7) and *Search for support* (A5). None of the dimensions were entered in the model as they failed to be significative. The final R^2 was 0.14.

Our thirst set of hypothesis explored the relationship of personality with school absences. The facet level model outperformed the dimensional level ($F = 6.80$, p < 0.001), $\Delta R^2 = 0.11$. The most important predictors were *Open mindedness* (O3), *Wish to analyze* (O6), *Interest in reading* (O4), *Equanimity* (N1) and *Genuineness* (A7) inversely and *Carefreeness* (N3) and *Low competitiveness* (A3) directly related to abseentism. The facet level model reached a 12.6% of explained variability of abseentism.

< 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

⁴⁵⁶

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 $< .01$ as
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

480 sample. All facets loaded significantly on their intended domain.

481 **Results of MI.** For analyzing measurement invariance the latest facet model
482 structure (with additional facets) was taken. The results are shown in Table 7. Configural
483 measurement invariance could be shown for the facets *Appreciation of others*,
484 *Superiority/Grandiosity, Need to be liked, Crybabiness, Manipulation, Altruism* (facets of
485 Agreeableness), *Perseverance, Task Planning, Goal-orientation/Achievement striving*,
486 *Preferred Load, Procrastination* (facets of Conscientiousness), *Assertiveness*,
487 *Sociability/Gregariousness, Activity* (facets of Extraversion), *Irritability, Self-serving*
488 *Attention* (facets of Neuroticism), *Self-attributed Inginuity, Openness to actions and*
489 *activities, Openmindedness/Judgement, Love of Learning, Openness to feelings* and *Intellect*
490 (facets of Openness).

491 Factorial measurement invariance could be shown for the facets *Meanness, Trust*
492 (facets of Agreeableness), *Control of others, Lack of (Self-) Control, Deliberation/Caution*,
493 *Lack of Tidiness/Order* (facets of Conscientiousness), *Sensation Seeking, Reclusiveness*,
494 *Emotionality, Humor* (facets of Extraversion), *Depression, Anxiety, Self-assuredness*,
495 *Lethargia, Sentimentality* (facets of Neuroticism), *Openness to reading, Openness to arts* and
496 *Need for cognition* (facets of Openness).

497 The only facet with strong factorial measurement invariance was *Shyness*, a facet of
498 Extraversion.

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 repeatedly been found when fitting EFA to personality data, its replicability under CFA procedures has been more elusive (R. R. 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 presented in this work covers all the "core" facets proposed by C. J. 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 C. 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.

In addition, the instrument includes more facets that are usually out of the scope within the other big five inventories which were examined in this study. For instance, *Search for support* (A5) is absent in the big five inventories revised here and may take an important role in predicting many different life outcomes, like mental disorder prognosis or academic development. Likewise, *Forcefulness* (E5) can be a good predictor of leadership in a human resource setting, a facet which is not clearly tapped in the other inventories. Not only new facets can be found in our inventory, but also more complex nuances of classic facets. *Appreciation* (A1) and *Good faith* (A6) are two sepparate facets in our instrument which suggest different approaches to the shared NEO-PI-R, IPIP-NEO-120 and NEO-PI-R's facet *Trust*. In the same vein, NEO-PI-R's *Deliberation*, BFI-2's *Organization* and IPIP-NEO's *Cautioness* may be included within two of our Conscientiousness facets: *Task planning* and *Carefulness*. This expansion of the facet structure opens big posibilities when predicting behavior based in personality, as has been introduced in the criterion validity section.

We have tested different hypothesis which aim to replicate previous findings on the interplay between personality and SWL, academic performance and school abseentism. Overall, the instrument presented here has shown at least a similar predictive ability with its peers, finding even bigger associations with some outcomes. As stated in the introduction, Schimmack et al. (2004) could explain 30% of the variability of SWL with a set of NEO-PI-R facets. We reached to a 38% with our instrument. Evidence regarding academic

achievement was similarly attained. While a 10% increase has been reported in the literature in favor of a facet-level set of predictors, we have found a 12% increase in R^2 with our instrument. Absences from class could also be predicted with the facet structure of our instrument, explaining about 13% of the variability of the outcome and providing a novel set of facets which could be key in understanding this behavioral outcome. All in all, the benefits from using a broad facet measure of personality have been shown within the criterion ability section.

The instrument has been tested in two different populations, collecting promising evidence of factor invariance. Most of the facets have shown to be invariant between populations, at least at the configural level, with the exception of two facets of Extraversion (names between table1 and table7 are not equal, what are the final names of the facets?). We have to bear in mind at this point that the two populations are not equivalent in terms of age, and this factor may hinder significantly any evidence of factor invariance.

The usefulness of this inventory in the clinical realm has not being explicitly proven but can be inferred with the external evidence provided. The multiple facets in the Emotional stability / Neuroticism continuum would allow to detect adaptative and maladaptative styles of behavior.

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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Table captions