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

2                                  personality

3               Victor Rouco[1,2], Anja Cengia[3], & Matthias Ziegler[3]

4                          [1] Universitat de Barcelona

5                       [2] Institut de Neurociències de Barcelona

6                       [3] Humboldt Universität zu Berlin

7                                  Author Note

8        Add complete departmental affiliations for each author here. Each new line herein

9    must be indented, like this line.

10       Enter author note here.

11       Correspondence concerning this article should be addressed to Victor Rouco, Postal

12   address. E-mail: victorrouco@ub.edu

## Abstract

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

## 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 L. R. 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 (L. R. Goldberg et al.,

103 2006), and the HEXACO model (K. Lee & Ashton, 2016), which assumes six broad domains.

104 *Table 1* gives an overview of these different models listing their facets per domain as well as

105 some 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

(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 Christopher 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 (Christopher J 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 Christopher 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. We hypothesize that the facets *Confidence* (N2) and *Positive attitude* (E4) developed in our instrument will behave similarly

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

169   scores with facets such as *Achievement-striving* (Chamorro-Premuzic & Furnham, 2003;

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

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

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

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

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

175   O'Connor & Paunonen, 2007, $r$ ranging from .25 to .38). Moreover, narrow level analysis

176   seems to improve the predicitive power of personality on academic performance, adding

177   about 10% of explained variance (Lounsbury, Steel, Loveland, & Gibson, 2004; O'Connor &

178   Paunonen, 2007; Ziegler, Danay, Schölmerich, & Bühner, 2010). Openness. . .

179        At the facet level, O'Connor and Paunonen (2007) found that *Achievement-striving*,

180   *Self-discipline* and *Dutifulness* were the best predictors of academic performance, ranging

181   from $r = .15$ to $r = .39$, from $r = .18$ to $r = .46$, and from $r = .25$ to $r = .46$ respectively.

182   In the inventory presented here, the facets *Persistence* (C2), *Self-discipline* (C3) and

183   *Carefulnes* (C6) are the most related with the previous. Our second hypothesis would be to

184   replicate this findings. Openness is also supposed to play an important role in predicting

185   academic achievement, however evidence has been elusive at the dimension level (Ziegler et

186   al., 2010). Openness to ideas has been found to be a facilitator towards better GPA, wih

187   correlations being found $r = .22$ in Dollinger and Orf (1991) and $r = .15$ in Ziegler et al.

188   (2010). We expect to find similar correlations with *Open mindedness* (O3) in our third

189   hypothesis. Often different facets within the same domain can have effects in opposite

190   directions, partially canceling out the predictive ability of the dimensions. This could be the

191   case of Openness to experience, were facet-level analysis can be unveiling. Openness to

192   fantasy has found to yield a negative relation to GPA $r = -.22$ for men, whereas Aesthetics

193   yielded a similar relationship with GPA for women $r = -.19$ (De Fruyt & Mervielde, 1996).

194   In our case we expect that *Creativity* (O1) yield negative correlations with GPA for both

195   sexes, and the overall effect of Opennes on academic achievement being nearly zero, this will

196  be our fourth hypothesis.

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

198  abseentism (Judge, Martocchio, & Thoresen, 1997; Salgado, 2002). Research has highlighted

199  the predictive power of personality test over the so-called integrity test when predicting

200  absences (Ones, Viswesvaran, & Schmidt, 2003). Again, most research has focused on the

201  dimensional level, although some researchers suggested that personality assessed at a

202  narrower level would improve the predictive ability of the models (Lounsbury et al., 2004;

203  Salgado, 2002). Nonetheless, few studies have explored this relationship to our knowledge,

204  being Lounsbury et al. (2004) and Judge et al. (1997) the most prominent. Judge et al.

205  (1997) reported no predictive gain when examining personality at the facet level for the

206  NEO-PI-R composites of Extraversion and Conscientiousness, whereas Lounsbury et al.

207  (2004) found a modest predictive gain of *Work drive* over the Big Five dimensions. Therefore,

208  and despite the conceptual expectation of facets maximizing the predictive ability of

209  personality on abseentism, evidence has manifested in favour of a dimension level analysis.

210  Our sixth hypothesis of the criterion validity section will be that *Persistence* (C2) will add a

211  significative proportion of variance explained in the model which includes the five

212  dimensions, in line with Lounsbury et al. (2004). Furthermore, this study would help to

213  envision which facets could be involved in the relation between personality and school

214  abseentism, as an exploratory research question. **SAY SOMETHING ABOUT**

215  **Chamorro-Premuzic and Furnham (2003)**

216  As described above, facet measures often yield scores that have stronger test-criterion

217  correlations than their respective domain scores. However, facet scores have also been shown

218  to be related to personality disorders. Thus, the combination of a higher fidelity along with

219  the potential clinical relevance of facet scores might open up unique advantages for clinical

220  research.

## 1.4. The Big Five and Personality Disorders

Personality disorders are steadily shifting from a categorical definition into a continua conceptualization within the clinical realm. This process is not new for personality science history, as the subject itself moved from a qualitatively distinct set of definitions, called types, into a subset of continuous domains in which both normality and extreme tendencies were moving along, named traits. In fact, the new version of the Diagnostic and Statistical Manual of mental disorders, DSM-V, now proposes two different ways of assessing personality disorders: 1) A descriptive model of personality disorders in section II which mimics the former model of assessing personality disorders and; 2) A novel trait model that follows research on the personality scientific domain (In section III), which conceptualizes personality disorders as extreme tendencies located in the continuum of the Big Five domains and facets (American Psychiatric Association, 2013; T. A. Widiger & Mullins-Sweatt, 2009)

This paradigm shift in clinical assessment of personality has led to the construction of the Personality Disorder Inventory (PID-5; R. F. Krueger, Derringer, Markon, Watson, & Skodol, 2012), a 25-facet and five-dimension self-report inventory, with an informant-report version (K. E. Markon, Quilty, Bagby, & Krueger, 2013). These five dimensions mirror the Big Five domains, although with a focus on the maladaptative end of the continuum,: I) Detachment (Big Five's Introversion), II) Antagonism (absence of Big Five's Agreeableness), III) Disinhibition (absence of Big Five's Conscientiousness), IV) Negative affect (Big Five's Neuroticism) and V) Psychoticism (Absence of Big Five's Openness). The PID-5 has shown satisfying evidences of criterion validity (... summary). However, the number of facets per domain on the PID-5 is limited.

In line with what has been stated previously for academic achievement, the examination of facets may result in an enhancement of the specificity of assessment when looking at the nature of PDs (L. A. Clark, 2005; Samuel & Widiger, 2008). This

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

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

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

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

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

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

facets within the same dimension or in a lack of coverage for essential characteristics of the

PD. For example, aberrant cognitions are essential characteristics of schizotypal disorder and

are not covered by some instrument's facets like the NEO-PI-R (Samuel & Widiger, 2008;

Saulsman & Page, 2004). Likewise, the expected high scores on warmth and low scores on

assertiveness could mask the effects of extraversion when predicting Dependent Personality

Disorder, following the theoretical correspondence between PD and Big Five facets proposed

by Costa Jr. and Widiger (1994). Moreover, the PID-5 has prompted the elaboration of a

number of Five Factor Model Personality Disorders (FFMPD) scales to maximize the facet

coverage in relation to specific PDs (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). Measurement

invariance across samples will be examined. Internal consistency and test-criterion

271 correlations will be estimated for the scores. To sum up, the aim for this research project

272 was to provide an instrument that can be used in non-clinical but also in clinical research

273 which emphasizes the facet level of the Big Five.

## Methods

275        Two different studies are presented in this work. The first study uses a sample drawn

276 from the USA bachelor student population. The aim was to detect and confirm a model that

277 maximizes the facet space below the Big Five domains. Exploratory factor analysis (EFA)

278 was used to identify the number of facets per domain. A confirmatory factor analysis (CFA)

279 per facet was specified in order to confirm the item - facet relationship. Reliability measures

280 for the facets and test-criterion correlations will be computed to achieve evidences of

281 reliability and criterion validity. Finally, an exploratory structural equation model (ESEM)

282 was applied to test a full model in which the facets serve as indicators of the Big Five

283 domains. ESEM has gained reputation in the personality field, where the independent cluster

284 model may not capture the complexity of the constructs measured (Marsh et al., 2010).

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

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

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

288 proposed model.

### Study 1 - US-American Sample

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

291 (59.30% male) who participated voluntarily. The mean age was 21.60 years (SD = 5.90).

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

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

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

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

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

297 **Measures**

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

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

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

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

302 contains over 2000 items (L. R. Goldberg et al., 2006). Participants were asked to rate

303 themselves on typical behaviors or reactions on a 5-point Likert scale, ranging from 1 ("Not

304 all like me") to 5 ("Very much like me").

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

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

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

308 more participants.

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

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

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

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

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

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

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

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

³¹⁷        **SAT.**

³¹⁸        **ACT.**

³¹⁹        **Absences from class.**    As a behavioral measure absence from class was asked to
³²⁰  report from subjects. ABS2 ABS4 what are the differences?

³²¹  **2.1.3.  Procedure**

³²²        **EFA with subsample 1.**    To determine the number of possible facets per domain
³²³  Velicer (1976) Minimum Average Partial (MAP) method and Horn (1965) parallel analysis
³²⁴  (PA) were employed for every domain. Based on these results an Exploratory Factor
³²⁵  Analysis (EFA) was calculated for each domain via Mplus using a geomin rotation (Quelle)
³²⁶  and a Maximum Likelihood estimator (ML). The decision for the preferred number of facets
³²⁷  per domain was based partly on comparing model fits (CFI, RMSEA, SRMR). More
³²⁸  importantly though was the interpretability of the facet solution. To this end, facet solutions
³²⁹  from other personality measures were looked and compared to the found facet structure. If
³³⁰  there were important parts missing to present the domain with regards to content, new
³³¹  facets were added a posteriori.

³³²        **CFA and ESEM with subsample 1.**    To confirm the structure of facets the EFAs
³³³  delivered, multiple CFAs were calculated via Mplus. In a first step, measurement models
³³⁴  were estimated for each of the facets. To obtain balance between the facets, the items were
³³⁵  reduced to five per facet based on item content and loading pattern. In a second step, the
³³⁶  estimations for the measurement models on facet levels were repeated via CFA. For both
³³⁷  steps estimators were WLSMV (Weighted Least Squares adjusted for Means and Variances).
³³⁸  Aim was to ensure an optimal breadth and sufficient reliability. In a final model, all five
³³⁹  domain structural models were integrated using ESEM (Asparouhov & Muthén, 2009).
³⁴⁰  Marsh et al. (2010) could show that ESEM fits personality data better and results in

substantially more differentiated factors than CFA. All facets were allowed to load on all

domains. If there would show up facets that do not significantly load on the intended

domain, this facets would get eliminated subsequently. The estimators used were ML

!WLSMV?, factor scores from the facet CFAs were used as indicators and the rotation was

oblique (using Geomin). Model fit was determined based on the guide lines by Hu and

Bentler (1999) as well as Beauducel and Wittmann (2005). Consequently, to consider a good

fit of a proposed model, the Comparative Fit Index (CFI) should be at or over .95, the

Standardized Root Mean Squared Residual (SRMR) smaller than .08 and the Root Mean

Square Error of Approximation (RMSEA) smaller than .06. For the ESEM models we

compared our results with the findings by Marsh et al. (2010).

**Reliability**

Chronbach's $\alpha$ and McDonald's $\omega$ 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 the first hypothesis we fitted a linear model that included N2 and E4 as

predictors and SWL as citerion. Furthermore we fitted a stepwise regression using all the

facets to find other important relations. In a third model we compared the power of E4 and

N2 predicting SWL against their respective domains, Extraversion and Neuroticism.

The second to sixth hypothesis involves academic achievement 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

365 regression were all the Conscientiousness facets will form the initial set of predictors. The

366 fifth hypothesis will be explored with a simple regression of O3 on high school grades. The

367 sixth hypothesis will be explored by inspecting the correlation of the facets forming

368 Openness with academic achievement.

369 The seventh hypothesis involves the relations between educational abseentism and

370 personality. To explore whether C2 would add predictive power to the five dimensions on

371 predictive absences, we will fit a two step regression. Finally, a stepwise regression of all

372 facets on school absentism will be fitted to explore predictions at the facet level.

## Results

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

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

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

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

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

379 < Table 2 here>

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

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

382 were named Appreciation, Integrity, Low Competitiveness, Readiness to Give Feedback,

383 Search for Support, Good Faith, Genuineness and Altruism.

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

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

386 Goal orientation, Carefulness, Orderliness, Wish to work to capacity and Productivity.

<sub>387</sub>    Extraversion is formed by nine facets. A new facet (Energy) was added in order to tap

<sub>388</sub> better the physical component of Extraversion, which was missing in the eight facet solution.

<sub>389</sub> The facets are Sociability, Readiness to take risks, Wish for affiliation, Positive attitude,

<sub>390</sub> Forcefulness, Communicativeness, Humor, Conviviality and Energy.

<sub>391</sub>    Neuroticism (interpreted here as emotional stability) consists of seven facets. One facet

<sub>392</sub> was dropped due to poor interpretability, and was therefore not included in the subsequent

<sub>393</sub> analyses. The final set of facets are named Equanimity, Confidence, Carefreeness, Mental

<sub>394</sub> balance, Drive, Emotional robustness and Self-attention.

<sub>395</sub>    Openness to experience comprises nine facets. One facet was identified as a method

<sub>396</sub> factor and eliminated, because it solely contained negatively formulated items and no

<sub>397</sub> coherent underlying trait could be identified. Furthermore another facet (Intellect) was

<sub>398</sub> added, because the remaining facets lacked an intellectual content. The facets of Openness

<sub>399</sub> are named Creativity, Wish for variety, Open-mindedness, Interest in reading, Artistic

<sub>400</sub> interests, Wish to analyze, Willingness to learn, Sensitivity and Intellect.

<sub>401</sub>    The items to each facet are listed in the appendix (A).

<sub>402</sub>    **Results of CFA and ESEM.**   All measurement models for the facets fitted well,

<sub>403</sub> results are summarized in *Table 3*. In this table both models with five items only and models

<sub>404</sub> with all items are presented with their respective model fit. The 5-item facets normally

<sub>405</sub> outperform the models including all items regarding model fit.

<sub>406</sub>    < Table 3 here caption="Model fit for each facet")>

<sub>407</sub>    The ESEM of the final model with all five domains yielded an acceptable fit (Marsh et

<sub>408</sub> al., 2010): CFI = .87, RMSEA = .072, SRMR = .036. As it can be seen in *Table 4* nearly all

<sub>409</sub> facets loaded significantly on their intended domain. Some cross loadings emerged as is

410 typical for ESEM procedures.

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

412 **Reliability.** Reliabilities for the 5 item facets were calculated with $\alpha$ and $\omega$ estimates.

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

414 0.68, and mean $\omega = 0.70$. Openness' mean $\alpha = 0.76$, and mean $\omega = 0.77$. Neuroticism mean

415 $\alpha = 0.68$, and mean $\omega = 0.69$. TExtraversion's mean $\alpha = 0.72$, and mean $\omega = 0.74$.

416 **Criterion validity evidence.** Our first hypothesis concerning external criteria

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

⁴³⁴ towards achieving higher grades. We have found a correlation of $r = 0.14$ between this facet

⁴³⁵ and high school grades, in line with the findings of Ziegler et al. (2010). Furthermore, we

⁴³⁶ expected some inverse correlations between the facets of Openness, and as a result a near

⁴³⁷ zero correlation with the dimension. We haven't found any Openness facet with a significant

⁴³⁸ inverse correlation with high school grades, and as indicated previously our results don't

⁴³⁹ support a zero correlation of the dimension with high school grades.

⁴⁴⁰          Another relevant outcome that has shown to be best predicted with personality at the

⁴⁴¹ facet level is academic achievement. The relation of Conscientiousness with school grades has

⁴⁴² gained a stable empirical evidence, widely inspected in the meta-analysis by O'Connor and

⁴⁴³ Paunonen (2007) were the mean $\rho$ was .24. At the facet level, O'Connor and Paunonen

⁴⁴⁴ (2007) found that *Achievement-striving*, *Self-discipline* and *Dutifulness* were the best

⁴⁴⁵ predictors of academic performance, ranging from $r = .15$ to $r = .39$, from $r = .18$ to $r = $

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

⁴⁴⁷ *Persistence* (C2), *Self-discipline* (C3) and *Carefulnes* (C6) are the most related with the

⁴⁴⁸ previous. Our second hypothesis would be to replicate this findings. Openness is also

⁴⁴⁹ supposed to play an important role in predicting academic achievement, however evidence

⁴⁵⁰ has been elusive at the dimension level (Ziegler et al., 2010). Openness to ideas has been

⁴⁵¹ found to be a facilitator towards better GPA, wih correlations being found $r = .22$ in

⁴⁵² Dollinger and Orf (1991) and $r = .15$ in Ziegler et al. (2010). We expect to find similar

⁴⁵³ correlations with *Open mindedness* (O3) in our third hypothesis. Often different facets

⁴⁵⁴ within the same domain can have effects in opposite directions, partially canceling out the

⁴⁵⁵ predictive ability of the dimensions. This could be the case of Openness to experience, were

⁴⁵⁶ facet-level analysis can be unveiling. Openness to fantasy has found to yield a negative

⁴⁵⁷ relation to GPA $r = -.22$ for men, whereas Aesthetics yielded a similar relationship with

⁴⁵⁸ GPA for women $r = -.19$ (De Fruyt & Mervielde, 1996). In our case we expect that

⁴⁵⁹ *Creativity* (O1) yield negative correlations with GPA for both sexes, and the overall effect of

⁴⁶⁰ Opennes on academic achievement being nearly zero, this will be our fourth hypothesis.

461     The second to sixth hypothesis involves academic performance as criterion variable.

462 The second and third hypothesis will be explored via inspection of the correlation matrix

463 with the Big Five dimensions. The fourth hypothesis will be explored by means of a stepwise

464 regression were all the Conscientiousness facets will form the initial set of predictors. The

465 fifth hypothesis will be explored with a simple regression of O3 on high school grades. The

466 sixth hypothesis will be explored by inspecting the correlation of the facets forming

467 Openness with academic achievement.

468     Bivariate correlations of the facets with the external criteria are shown in *Table 5*. The

469 facets N2 (Confidence, r = 0.53) and E4 (Positive attitude, r = 0.49) show the highest

470 correlations with life satisfaction respectively. The SWL scale was also correlated with facets

471 such as N4 (Mental balance, r = 0.25) and N5 (Drive, r = 0.27) in the Neuroticism /

472 Emotional stability realm. C5 (Goal orientation, r = 0.28) and C2 (Persistence, r = 0.27) in

473 Conscientiousness. E1 (Sociability, r = 0.26) and E9 (Energy, r = 0.25) in the Extraversion

474 domain. O9 (Intellect, r = 0.24) and O3 (Open-mindedness, r = 0.22) in Openness and A6

475 (Good faith, r = 0.25) in the Agreeableness domain.

476     Regarding the academic performance criteria (GPA, SAT and ACT), the Openness

477 facets O4 (Interest in reading), O6 (Wish to analyze) and O9 (Intellect) yield the most

478 consistent correlations. Interestingly, O4 correlates directly with the reading subtests of SAT

479 (r = 0.25) and ACT (r = 0.2) and shows a negligible relationship with the math (r = 0.06 /

480 0.08) subscales.

481     Furthermore, the global GPA scale (assuming cc is for global) correlated with several

482 Conscientiousness and Agreeableness facets. C9 (Productivity, r = 0.4), C5 (Goal

483 orientation, r = 0.38) and C4 (Task planning, r = 0.35) yield the higher correlations with

484 overall GPA respectively in the Conscientiousness domain, and A1 (Appreciation, r = 0.32)

485 in the Agreeableness domain.

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

< Table 5 here caption="Criterion correlations" >

**Study 2 – German Sample**

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

**Measures.**   The five items per facet derived from Study 1 were translated and back-translated by bilingual experts, creating a German version of the measure used there. The translated items can be found in appendix B.

**Procedure**

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

**Step 2 – Testing for measurement invariance.**   In a next step, measurement invariance between German and US samples was examined. We followed the procedure

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

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

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

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

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

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

513   intercepts of each item are equal. The limit to factorial measurement invariance was set to $\Delta$

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

515   measurement invariance was set to $\Delta$ CFI $< .01$, $\Delta$ RMSEA $< .015$, $\Delta$ SRMR $< .01$ as

516   suggested by Chen (2007).

## Results

518   **Results of CFA.**   The measurement models of the American sample were replicated

519   for the reduced number of items per facet. Model fits can also be seen in *Table 3*. The

520   ESEM with all five domains showed a relatively good fit to the data with CFI $= .82$,

521   RMSEA $= .078$, SRMR $= .044$. *Table 6* shows the ESEM factor loadings for the German

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

523   **Results of MI.**   For analyzing measurement invariance the latest facet model

524   structure (with additional facets) was taken. The results are shown in Table 7. Configural

525   measurement invariance could be shown for the facets *Appreciation of others*,

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

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

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

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

530   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

## 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

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

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

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

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

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

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

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

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

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

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

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

565  *Communicativeness* and *Conviviality* facets. *Altruism* is directly reflected in a five-item facet,

566  while the *Compliance* construct is reflected by our *Good faith* facet. The *Order* and

567  *Self-discipline* constructs proposed by Christopher J. Soto and John (2009) are mirrored by

568  dedicated facets in our instrument. The *Anxiety* and *Depression* constructs are mirrored by

569  the facets *Mental balance* and *Emotional robustness*, respectively. For the *Openess*

570  dimension, the *Aesthetic* contruct is covered by our facet *Artistic interest*, while the *Ideas*

571  construct has been reflected by both the *Open-mindedness* and the *Wish to analyze* facets.

572  The two-per-facet components proposed by DeYoung et al. (2007) were also being tapped by

573  the set of facets in our inventory.

574      The instrument covers most of facets proposed by the most influential Big Five

575  measures as seen in *Table 1*. The most salient differences are related to the HEXACO model,

576  which entails a six factor solution with a slightly different theoretical conceptualization (K.

577  Lee & Ashton, 2006). Most notably

578      Although these facets are not being covered directly in our inventory, components of

579  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 multi - facetted nature of the instrument makes forthcoming evidences for criterion and predictive validity promising.

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

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

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

600 Brick and Lewis (2014); Gaughan, Miller, and Lynam (2012); Leone, Chirumbolo, and
601 Desimoni (2012); Mcabee, Oswald, and Connelly (2014); Gaughan, Miller, Pryor, and Lynam
602 (2009); Noftle and Shaver (2006); R. M. Bagby, Taylor, and Parker (1994); Schimmack, Furr,
603 and Funder (1999); Wakabayashi, Baron-Cohen, and Wheelwright (2006); Shaver and
604 Brennan (1992); Ruiz, Pincus, and Dickinson (2003); Mccrae, Kurtz, Yamagata, and
605 Terracciano (2011); Rosander, Bäckström, and Stenberg (2011); K. K. McAdams and
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# Table captions