The Berlin Multi-Facet Personality Inventory: A Comprehensive Measure of Big Five Personality Facets

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Abstract

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Over the last decades, the Five Factor Model (Costa & McCrae, 1992) as well as the Big Five (Goldberg, 1990; Digman, 1990) have become widely accepted models for describing general attributes of personality[[1]](#footnote-1). In both cases, personality is conceived as a hierarchical model which describes human individual differences in personality at the dispositional level: One of the most basic, universal, biologically-influenced, and stable layer of inter-individual differences in behavior, cognition and feeling (McAdams & Pals, 2006). This hierarchical conception is relevant to acknowledge behavior from the most specific (nuances) to the more general (domains) differences in personality, through a varying number of mid-level characteristics (facets). Most of the research concerning criterion validity of Big Five inventories has focused on the covariation between the Big Five domains and relevant external outcomes. However, specific dispositional characteristics captured on the facet level might be of extreme utility to provide more complex descriptions of individuality and to predict life outcomes to a major extent (John et al., 2014; Lounsbury, Sundstrom, Loveland, & Gibson, 2002; Paunonen & Ashton, 2001; Ziegler et al., 2014; Ziegler, Danay, Schölmerich, & Bühner, 2010). Unfortunately, the number and nature of facets below the Big Five domains is far from being consensual. In fact, many different sets of facets have been proposed (Goldberg, 1999). One potential reason for this proliferation could be that many facet-level models were developed as an elaboration or extension to an existing measure. This ad-hoc inception has the disadvantage of potentially limiting the search space for possible facets, while at the same time provides a window of opportunity for elaborating exhaustive taxonomies related to the Big Five.

## 1.2. Different Facet Models

As outlined above, there are a number of models that include a facet structure below the five broad domains. Among them, probably the most widely known is the proposal by Costa and McCrae (1995), the NEO-PI-R model, which defines six facets per domain. Other popular models include the Big Five Inventory 2 (BFI-2; Soto & John, 2016), the IPIP (Goldberg et al., 2006), and the HEXACO model (Lee & Ashton, 2016; which assumes six broad domains). *Table 1* provides an overview of these different elaborations, listing psychometric information such as internal consistency and correlations with external constructs. Other models have also been developed, although not listed in *table 1* due to limited space, such as the Faceted Inventory of the Five-Factor Model by Watson, Nus, & Wu (2017), or the Big Five Aspect Scales by DeYoung, Quilty, & Peterson (2007)

Table 1. Most common Big Five models

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Taxonomy | Domains | Facets | Reliability | Nom.net. /Number of items | No. of items |  |  |  |
|  |  |  |  |  |  |  |  |  |
| HEXACO-PI-R |  |  | (Lee & Ashton, 2016) | 100 | 100\*, 60 |  |  |  |
|  | Humility |  |  |  |  |  |  |  |
|  |  | Sincerity | 0.66 |  |  |  |  |  |
|  |  | Fairness | 0.76 | - Psychopathy (-.66),  - Antisocial behavior (-.44)  (Gaughan, Miller, Lynam, 2012);  + Ethics/Integrity (.22)  (McAbee et al., 2014) | | | |  |
|  |  | Greed Avoidance | 0.81 | - Social Dominance  Orientation (-.45)  (Leone et al., 2012) |  |  |  |  |
|  |  | Modesty | 0.68 |  |  |  |  |  |
|  | Emotionality |  |  |  |  |  |  |  |
|  |  | Fearfulness | 0.70 |  |  |  |  |  |
|  |  | Anxiety | 0.64 |  |  |  |  |  |
|  |  | Dependence | 0.80 |  |  |  |  |  |
|  |  | Sentimentality | 0.70 | - Callous affect (-.68)  (Gaughan et al., 2012);  + Diversity **(**.22**)**  (McAbee, Oswald, Connelly, 2014) | |  |  |  |
|  | Extraversion |  |  |  |  |  |  |  |
|  |  | Social Self-Esteem | 0.67 | + Adaptability / Life skills (.25)  **(**McAbee et al., 2014**)** |  |  |  |  |
|  |  | Social Boldness | 0.76 | + Emision-reduction behavior  (Brick & Lewis, 2014)  + Leadership (.36) (McAbee et al., 2014) | |  |  |  |
|  |  | Sociability | 0.71 |  |  |  |  |  |
|  |  | Liveliness | 0.76 | + Adaptability / Life skills (.25),  + Social responsability (.22),  + Health **(**.21**)** (McAbee et al., 2014) | |  |  |  |
|  | Agreeableness |  |  |  |  |  |  |  |
|  |  | Forgivingness | 0.74 |  |  |  |  |  |
|  |  | Gentleness | 0.66 |  |  |  |  |  |
|  |  | Flexibility | 0.61 |  |  |  |  |  |
|  |  | Patience | 0.79 |  |  |  |  |  |
|  | Conscientiousness |  |  |  |  |  |  |  |
|  |  | Organization | 0.74 |  |  |  |  |  |
|  |  | Diligence | 0.70 | + GPA (.31),  + Adaptability / Life skills (.37),  + Perseverance **(**.50**)**  (McAbee et al., 2014) | |  |  |  |
|  |  | Perfectionism | 0.69 | + Emision-reduction behavior **(**.25**)**  (Brick & Lewis, 2014) |  |  |  |  |
|  |  | Prudence | 0.69 | - Erratic life-style **(**-.58**)**  (Gaughan et al., 2012) |  |  |  |  |
|  | Openness |  |  |  |  |  |  |  |
|  |  | Aesthetic | 0.66 | + Emision-reduction behavior (.33) ,  + Connectedness to nature (.51)  (Brick & Lewis, 2014);  - Right Wing Authoritarism (-.37)  (Leone et al., 2012);  + Continuous learning (.30)  (McAbee, 2014)  + Artistic appreciation (.43)  (McAbee et al, 2014) | | | | |
|  |  | Unconventionality | 0.52 | - Political Conservatism **(**.29**)**  (Brick & Lewis, 2014) |  |  |  |  |
|  |  | Creativity | 0.75 |  |  |  |  |  |
|  |  | Inquisitiveness | 0.66 | + Continuous learning (.30)  **(**McAbee et al, 2014**)** |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| NEO-PI-r |  | (McCrae et al., 2011) | | 240 | 240 |  |  |  |
|  | Neuroticism |  |  |  |  |  |  |  |
|  |  | Anxiety | 0.78 | - Fearless dominance (-.49)  (Gaughan et al, 2009) |  |  |  |  |
|  |  | Angry Hostility | 0.75 | + Callous / Manipulation (.29)  + Dysregulation / Disinhibition (.48)  + Anti-social behavior (.26)  (Gaughan et al, 2009) | | | |  |
|  |  | Depression | 0.81 | + Attachment Anxiety (.49),  + Attachment avoidance (.26)  (Noftle & Shaver, 2006);  + Alexithymia (.36)  (Bagby, Taylor, Parker; 1994);  - Satisfaction with life (-.52)  (Schimmack et al., 2004);  + Avoidant attachment style (.32),  + Anxious attachment style (.32) ,  - Secure attachment style (-.39)  (Shaver & Brennan, 1992) | | | | |
|  |  | Self-Consciousness | 0.68 | + Autism-spectrum Quotient (.33)  (Wakabayashi et al., 2006);  + Avoidant attachment style (.32)  (Shaver & Brennan, 1992) | | | | |
|  |  | Impulsiveness | 0.70 | + Alcohol related problems (.29)  (Ruiz, Pincus & Dickinson, 2010) |  |  |  |  |
|  |  | Vulnerability | 0.77 |  |  |  |  |  |
|  | Extraversion |  |  |  |  |  |  |  |
|  |  | Warmth | 0.73 | + Secure attachment style  (Shaver & Brennan, 1992);  - Attachment avoidance (-.26)  (Noftle & Shaver, 2006) | | |  |  |
|  |  | Gregariousness | 0.72 | - Autism-spectrum Quotient (-.43)  **(**Wakabayashi et al., 2006**)** |  |  |  |  |
|  |  | Assertiveness | 0.77 |  |  |  |  |  |
|  |  | Activity | 0.63 |  |  |  |  |  |
|  |  | Excitement Seeking | 0.65 | + Fearless dominance **(**.53**)**  (Gaughan et al, 2009) |  |  |  |  |
|  |  | Positive Emotions | 0.73 | + Satisfaction with life (.40)  (Schimmack et al., 2004);  - Avoidant attachment style (-.30)  (Shaver & Brennan, 1992) | | |  |  |
|  | Openness |  |  |  |  |  |  |  |
|  |  | Fantasy | 0.76 |  |  |  |  |  |
|  |  | Aesthetics | 0.76 |  |  |  |  |  |
|  |  | Feelings | 0.66 | - Alexithymia (-.55) (Bagby et al., 1994) |  |  |  |  |
|  |  | Actions | 0.58 |  |  |  |  |  |
|  |  | Ideas | 0.80 |  |  |  |  |  |
|  |  | Values | 0.67 | + SAT verbal (.26)  **(**Noftle & Robins, 2007**)** |  |  |  |  |
|  | Agreeableness |  |  |  |  |  |  |  |
|  |  | Trust | 0.79 | - Attachment avoidance (-.26)  (Noftle & Shaver, 2006) |  |  |  |  |
|  |  | Straightforwardness  0,71 | | - Interpersonal manipulation (-.75)  (Gaughan et al., 2012);  - Supervisor rating  (Piedmont & Weinstein, 1994);  - Fearless dominance (-.49),  - Dysregulation / Disinhibition (-.49)  (Gaughan et al, 2009) | | | | |
|  |  | Altruism | 0.75 | - Callous affect (-.63),  - Antisocial behavior (-.37)  (Gaughan et al., 2009);  - Antisocial behavior (-.26)  (Gaughan, et al., 2012) | | | |  |
|  |  | Compliance | 0.59 |  |  |  |  |  |
|  |  | Modesty | 0.67 |  |  |  |  |  |
|  |  | Tender-Mindedness | 0.56 | - Callous affect **(**-.56**)**  (Gaughan et al., 2012) |  |  |  |  |
|  | Conscientiousness |  |  |  |  |  |  |  |
|  |  | Competence | 0.67 |  |  |  |  |  |
|  |  | Order | 0.66 |  |  |  |  |  |
|  |  | Dutifulness | 0.62 | - Dysregulation / Disinhibition (-.49)  **(**Gaughan et al, 2009**)** |  |  |  |  |
|  |  | Achievement Striving | 0.67 | + Supervisor rating (.23)  (Piedmont & Weinstein, 1994) |  |  |  |  |
|  |  | Self-Discipline | 0.75 | - Attachment anxiety (-.35)  (Noftle & Shaver, 2006);  - Dysregulation / Disinhibition (-.51)  (Gaughan et. al, 2009) | | |  |  |
|  |  | Deliberation | 0.71 | - Erratic life-style (-.57)  (Gaughan et al., 2012);  - Alcohol related problems (-.38)  (Ruiz et al., 2010) | |  |  |  |
|  |  |  |  |  |  |  |  |  |
| BFI-2 |  |  | (Soto & John, 2016) | 60 | 60 |  |  |  |
|  | Extraversion |  |  |  |  |  |  |  |
|  |  | Sociability | 0.83 | - Conformity (-.36),  - Tradition (-.24), +  Stimulation (.21),  + Positive affect **(**.32**)**  (Soto & John, 2016) | |  |  |  |
|  |  | Assertiveness | 0.80 | + Power **(**Soto & John, 2016**)** |  |  |  |  |
|  |  | Energy level | 0.74 | + Purpose in life (.53),  + Self-acceptance (.53),  + Social connectedness **(**.33**)**  (Soto & John, 2016) | |  |  |  |
|  | Agreeableness |  |  |  |  |  |  |  |
|  |  | Compassion | 0.68 | + Benevolence (.47),  - Power (-.44),  + Positive relations **(**.41**)**  (Soto & John, 2016) |  |  |  |  |
|  |  | Respectfulness | 0.66 | + Conformity **(**.39**)** (Soto & John, 2016) |  |  |  |  |
|  |  | Trust | 0.75 | + Universalism (.21), + Likability **(**.25**)** (Soto & John, 2016) |  |  |  |  |
|  | Conscientiousness |  |  |  |  |  |  |  |
|  |  | Organization | 0.76 | + Security **(**.30**)** (Soto & John, 2016) |  |  |  |  |
|  |  | Productiveness | 0.74 | - Hedonism (-.35),  + Achievement (.26),  + Environmental mastery (.56)  (Soto & John, 2016) | |  |  |  |
|  |  | Responsability | 0.68 | - Stimulation,  + Autonomy (Soto & John, 2016) |  |  |  |  |
|  | Negative Emotionality |  |  |  |  |  |  |  |
|  |  | Anxiety | 0.79 | - Autonomy **(**-.32**)** (Soto & John, 2016) |  |  |  |  |
|  |  | Depression | 0.74 | - Positive relations (-.56),  - Purpose in life (-.55),  - Environmental mastery (-.65),  -Self-acceptance(-.68),  - Positive affect **(**-.42**)**  (Soto & John, 2016) | | | | |
|  |  | Emotional Volatility | 0.70 | - Stress resistance **(**Soto & John, 2016**)** |  |  |  |  |
|  | Open-mindedness |  |  |  |  |  |  |  |
|  |  | Intellectual curiosity | 0.78 | + Self-direction (.44),  + Personal growth **(**.50**)**  (Soto & John, 2016) |  |  |  |  |
|  |  | Aesthetic Sensitivity | 0.67 |  |  |  |  |  |
|  |  | Creative Imagination | 0.67 |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| IPIP-NEO-120 |  |  | (Johnson, 2014) | 120 | 120 |  |  |  |
|  | Neuroticism |  |  |  |  |  |  |  |
|  |  | Anxiety | 0.78 |  |  |  |  |  |
|  |  | Anger | 0.87 |  |  |  |  |  |
|  |  | Depression | 0.85 |  |  |  |  |  |
|  |  | Self-Consciousness | 0.74 |  |  |  |  |  |
|  |  | Inmoderation | 0.72 | + Hangover symptoms **(**.35**)**  (McAdams & Donnellan, 2009) |  |  |  |  |
|  |  | Vulnerability | 0.76 |  |  |  |  |  |
|  | Extraversion |  |  |  |  |  |  |  |
|  |  | Friendliness | 0.81 |  |  |  |  |  |
|  |  | Gregariousness | 0.79 |  |  |  |  |  |
|  |  | Assertiveness | 0.85 |  |  |  |  |  |
|  |  | Activity Level | 0.71 |  |  |  |  |  |
|  |  | Excitement Seeking | 0.77 | + Alcohol Use (.45),  + Drinking problems **(**.37**)**  (McAdams & Donnellan, 2009) |  |  |  |  |
|  |  | Cheerfulness | 0.80 | + Addictive mobile phone  usage style **(**.28**)** (Siddiqui, 2011) |  |  |  |  |
|  | Openness to Experience |  |  |  |  |  |  |  |
|  |  | Imagination | 0.83 |  |  |  |  |  |
|  |  | Aesthetics | 0.76 |  |  |  |  |  |
|  |  | Emotionality | 0.69 |  |  |  |  |  |
|  |  | Adventurousness | 0.72 |  |  |  |  |  |
|  |  | Intellect | 0.75 |  |  |  |  |  |
|  |  | Liberalism | 0.64 | + Trendy mobile phone  usage style **(**.31**)** (Siddiqui, 2011) |  |  |  |  |
|  | Agreeableness |  |  |  |  |  |  |  |
|  |  | Trust | 0.86 |  |  |  |  |  |
|  |  | Morality | 0.76 | + Thrifty mobile phone  usage style (.48) (Siddiqui, 2011) |  |  |  |  |
|  |  | Altruism | 0.76 |  |  |  |  |  |
|  |  | Cooperation | 0.73 |  |  |  |  |  |
|  |  | Modesty | 0.76 |  |  |  |  |  |
|  |  | Sympathy | 0.72 |  |  |  |  |  |
|  | Conscientiousness |  |  |  |  |  |  |  |
|  |  | Self-Efficacy | 0.63 |  |  |  |  |  |
|  |  | Orderliness | 0.83 |  |  |  |  |  |
|  |  | Dutifulness | 0.69 |  |  |  |  |  |
|  |  | Achievement-striving | 0.80 | + Academic Performance **(**.23**)**  (Rosander, Bäckström & Sternberg, 2011) |  |  |  |  |
|  |  | Self-Discipline | 0.73 | + General health behaviors (.27)  (Hagger-Johnson & Whiteman, 2007) |  |  |  |  |
|  |  | Cautiousness | 0.87 |  |  |  |  |  |

Note: Reliability stands for internal consistency estimates (Cronbach’s α), retrieved from sources cited in the reliability column. Nom.net stands for nomological network. Coefficients in the nom.net column represent Pearson *r* coefficients. Numbers in the initial row of the predictive validity column represent number of items.

*Table 1* displays the abundance of proposed facets related to each of the Big Five domains, evidencing the reality of a topic that is not consensual and that gives rise to many different elaborations. Despite these differences, however, there is still some degree of overlap.

Soto and John (2009) inspected the convergence between the NEO-PI-R and the first version of the BFI, suggesting that two constructs per domain were measured at the facet level by both inventories. The constructs defined by Soto and John (2009) were: *Altruism* and *Compliance* for Agreeableness; *Anxiety* and *Depression* for Neuroticism; *Order* and *Self-Discipline* for Conscientiousness; *Assertiveness* and *Activity* for Extraversion; and *Aesthetics* and *Ideas* for Openness. Likewise, the existence of such “core” constructs was also suggested by DeYoung, Quilty, and Peterson (2007), in what they termed aspects. Even though both contributions’ labels vary, they have a substantial degree of similarity in terms of content. Furthermore, these core constructs are present not only in the models which Soto and John (2009) analyzed, but also in all models listed in *table 1*. Some of these constructs are explicitly covered (e.g. *Anxiety*), while others are implicitly encompassed, especially when given attention to the items’ content (e.g. *Liveliness* in HEXACO resembles the “core” construct *Activity*, present in all other instruments).

While the majority of models based on the Big Five include these “core” constructs into theirs, there is still an abundancy of other constructs which could be termed “peripheral” whose inclusion is more variable. One such example could be *self-consciousness*, a facet commonly ascribed to the domain neuroticism (defined in NEO-PI-R and IPIP-NEO-120), albeit not tapping any of the Neuroticism’s core constructs (*anxiety* and *depression*) and which is not present in many other models. Soto & John (2016) referred to this diversity of constructs by saying that the Big Five dimensions *“can be conceptualized and assessed more broadly or more narrowly”*, either by focusing on central or on peripheral facets, depending on the interest of research. It is due to this multiplicity of peripheral constructs that an effort to convey different models would be beneficial, in order to obtain a comprehensive inventory which subsumes the maximum possible of these peripheral facets, as well as including the essential core facets.

A possible layer between dimensions and facets has been suggested by DeYoung, Quilty, and Peterson (2007). Their work focused on the biological consistency of the NEO-PI-R set of facets, thereby proposing that each domain can first be split into two aspects: Agreeableness would be composed by *Compassion* and *Politeness*; Neuroticism by *Volatility* and *Withdrawal*; Conscientiousness by *Industriousness* and *Orderliness*; Extraversion by *Enthusiasm* and *Assertiveness*; and Openness by *Intellect* and *Openness*. Both Soto and John’s (2009) and DeYoung et al.’s (2007) proposals have many points in common.

An important step towards building such an extensive measure is to ensure that the proposed set of facets predict consequential outcomes. One of the most classical approaches to relate the constructs present in an inventory with external constructs is to define a nomological network between the personality traits and external outcomes (Cronbach & Meel, 1955). Nomological networks can be drawn from a hierarchical perspective, by either adopting narrow constructs, such as nuances, as personality units in the network or by utilizing broader domains. Relying on dimensions to describe behavior and to predict external outcomes can benefit from ease of interpretability. However, the domain level is sometimes too distal to depict behavioral mechanisms underlying personality-to-outcome associations thoroughly. Conversely, using nuances to predict behavior might yield a stronger predictive power (Seeboth & Mõttus, 2018), as specificity to situations and contexts is enhanced (Ziegler & Brunner, 2016). Nonetheless, using nuances in the prediction of external outcomes can have the disadvantage of dealing with extreme complexity when interpreting empirical findings. Facets are by definition in a middle ground between nuances and dimensions, in a compromise between specificity and sensitivity in the bandwidth-fidelity dilemma. This aggregation could satisfy the specificity of predictions while at the same time enhance the ease of interpretability of personality-to-outcome associations.

## 1.3 Facets predict consequential outcomes

The question of whether narrow measures have a superior predictive power over broad measures enjoys a lively debate nowadays. Research summarized below suggests an advantage for scores derived from more narrow measures. Nonetheless, other lines of research points at the opposite direction (Salgado, 2017; Chen, 2012). It falls out of the scope of this study to provide evidence which could fuel this debate further. Still, we believe that the inventory presented here will be useful to forthcoming contributions on this topic.

The following section provides an overview of evidence for relations between domains, facets, and three consequential outcomes that are of interest to researchers for obvious reasons. This outline has been included here in order to build a rationale of hypotheses which will guide the interpretation of our nomological network.

**1.3.1 Satisfaction with Life**

One of the outcomes that has been largely evidenced to be predicted by personality is satisfaction with life (SWL). Neuroticism and Extraversion have been consistently recognized as the most important broad domains predicting subjective life satisfaction (Diener, Oishi, & Lucas, 2003; Schimmack, Diener, & Oishi, 2002). Lately, Schimmack, Oishi, Furr, and Funder (2004) observed that facets outperformed domains in terms of predictive validity. They observed that scores for *Depression* and *Positive Emotions* / *Cheerfulness* explained SWL above and beyond neuroticism and extraversion. Correlations in the Schimmack et al. (2004) study ranged from *r* = -.57 to *r* = -.49 for *Depression,* and from *r* = .51 to *r* = .38 for *Positive Emotions / Cheerfulness*. In line with these findings, we hypothesize that the set of facets which measure Emotional Stability and Extraversion in our inventory would significantly correlate with SWL, with a moderate to big effect size.

**1.3.2 Academic Performance**

Another relevant outcome that has being typically predicted by personality is academic achievement. Conscientiousness has been recognized as the strongest Big Five dimension to predict this outcome. At the facet level, De Fruyt and Mervielde (1996) hypothesized that facets of Conscientiousness related to volition would be more strongly related with academic achievement. There is a collection of research that is consistent with this idea, linking academic performance 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 *Work drive* (Lounsbury et al., 2002, *r* = .12). Nonetheless, other Conscientiousness facets more related to duty or moral behavior have been found to predict GPA: for instance *Self-discipline* (O’Connor & Paunonen, 2007, *r* ranging from .18 to .25; Watson & Watson, 2002, *r* = .36), or *Dutifulness* (Chamorro-Premuzic & Furnham, 2003; O’Connor & Paunonen, 2007, *r* ranging from .25 to .38). The relation of academic achievement with Openness at the dimensional level has been more variant, in part because the facets of Openness can be related in opposite directions with this outcome. Paunonen and Ashton (2001) found that the Openness facet *Understanding* correlates with academic achievement in *r* = .23. Noftle and Robins (2007) identified a set of NEO-PI-R and HEXACO Openness facets which predicted academic achievement (the HEXACO facets of *Aesthetic*, *Inquisitiveness*, *Creativity* and *Unconventionality*, plus the NEO-PI-R facets of *Fantasy*, *Aesthetics*, *Feelings* and *Ideas*). Moreover, John et al. (2014) found that *Openness to ideas* was positively related to work performance, while *Openness to fantasy* was negatively related, potentially masking the overall effect of Openness over the working performance criterion. In line with these findings, we hypothesize that the facets which entail the Conscientiousness dimension in our inventory would consistently predict academic performance, with a small to moderate effect size, and that Openness to Experience will yield a mixed pattern at the facet level (Schwaba, Robins, Grijalva, & Bleidorm, 2019).

**1.3.3 Academic Absenteeism**

Personality has also been reported as a robust predictor of work and educational absenteeism, with especial attention to inverse correlations between this outcome and the domain conscientiousness (Chamorro-Premuzic & Furnham, 2003; Judge, Martocchio, & Thoresen, 1997; Salgado, 2002; Ones, Viswesvaran, & Schmidt, 2003). Some specific facets of conscientiousness have been highlighted, like *work drive* (Lounsbury et al., 2004) or *need for achievement* (﻿Wegge & Kleinbeck, 1993). Therefore, it would be reasonable to assume that conscientiousness will be the domain with stronger associations in our nomological network, and that facets pointing at volitional aspects of this domain will show this association more clearly. The relation of abseentism with the other four domains has been vaguer. Chamorro-Premuzic et al. (2003) as well as ﻿Furnham & Medhurst (1995) found significant direct correlations with openness, while direct correlations with extraversion were reported by ﻿Judge, Martocchio, and Thoresen (1997). Perhaps this ambiguity could be resolved by switching the focus to the facet level.

## 1.4 This research

Attending to the multiplicity of facet models available in the personality literature and the resurgence of narrow constructs as relevant units of analysis to describe personality and to predict important life outcomes, we developed a comprehensive measure of personality facets which covers the content of the Big Five domains to a major extent. This research thus exhibits the first effort in elaborating a personality inventory based in the full Big Five model which maximizes the number of facets. An antecedent to this study can be found in MacCann, Duckworth, and Roberts (2009), where data from the International Personality Item Pool (IPIP) was used in order to design a measure of Conscientiousness containing the maximum number of relevant facets. This research extends MacCann et al. (2009) to the full Big Five domains. Furthermore, the inventory presented here has been developed with the scope of being open source, by making it available to researchers and practitioners at no cost; and with the intention of facilitating internationally usage by testing its applicability in two different cultures.

In order to evidence its applicability among cultures, this research has been conducted in two studies using two independent samples from two different countries: the USA and Germany. In the first study, using the USA sample, we reported the procedure used to select the items and validate the internal consistency, higher order structure, and nomological network of our proposed set of facets. In study two, we replicated previous findings with a sampled based on Germany, and further tested the measurement equivalence of the suggested models. Methods and results sections are presented separately for each study. General discussion and conclusion sections are provided at the end of this manuscript.

## Study 1

### Methods

#### Participants

The sample of the first study consisted on 722 American undergraduate students (59.30% male) who gave voluntary acceptance to their inclusion in this research. Their mean age was 21.60 years (SD = 5.90), and 59% of them were female. Students were e-mailed a link to a computerized assessment battery that included the IPIP items as well as several other tests not reported in this paper. The data set was randomly split into two equally sized subsamples. Both subsamples were matched in relation to missing values, outliers, and extreme values. Subsample 1’s mean age was 21.80 years (SD= 6.30), subsample 2’s mean age was 21.50 years (SD=5.60).

#### Measures

##### Items from the International Personality Item Pool (IPIP)

Altogether, 525 items from the IPIP were used in this study, as indicators of the Big Five domains. The IPIP is an open source database of personality items, launched in 1996 and containing over 2000 items (Goldberg et al., 2006). Participants were asked to provide self-ratings of personality items on a 5-point rating scale, ranging from 1 (“Not all like me”) to 5 (“Very much like me”).

The item selection procedure was introduced in by MacCann, Duckworth, and Roberts (2009), and it is explained in detail there. That study also contains part of the sample used here. However, the current data set includes more participants.

##### Satisfaction with life (SWL)

Measured with a 5-item composite defined in Diener, Emmons, Larsen, and Griffin (1985), in a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Items included are: a) “In most ways my life is close to ideal”, b) “The conditions of my life are excellent”, c) “I am satisfied with my life”, d) “So far I have gotten the important things in my life”, and e) “If I could live my life over, I would change almost nothing”. Psychometric properties have been reported excellent. In our sample, the reliability estimate was α = 0.88.

##### Graded point average (GPA)

To measure academic performance, participants reported their GPA scores at the end of high school.

##### Absences

Participants reported an estimation of days that were absent from college without justification. This was an item extracted from a larger set of student social behaviors indicators (MacCann et al., 2009). Absences were log transformed prior to analyses, as proposed by Lounsbury et al. (2004).

#### Procedure

##### Exploratory Factor Analysis (EFA)

The first subset of the collected sample was used to identify the number of components underlying the personality items in our dataset, with a top-down approach as proposed by Goldberg (2006). Velicer’s (1976) Minimum Average Partial (MAP) and Horn’s (1965) Parallel Analysis (PA) methods were applied to correlation matrices in order to guide the subsequent factor analysis. Based on these statistics, a series of EFAs were calculated for each domain via Mplus (Muthen & Muthen, 20XX) using geomin rotation and Maximum Likelihood (ML) estimation. Decisions to retain facets were partly based on model fit information (CFI, RMSEA, SRMR) and partly on the interpretability of the facet solution. Additionally, alternative facet models inspired from other personality measures were considered and compared to the facet structure found by EFA. In case of omission of relevant content captured in other models, new items were added a-posteriori.

##### Reliability

Cronbach’s and McDonald’s were estimated for each facet score to provide evidence for the test scores’ internal consistency. The second subsample was used to compute these statistics.

##### Confirmatory Factor Analysis (CFA)

To verify the structure outlined by EFAs, one CFA per facet was fitted using the second subsample. We restricted the number of possible indicators to a maximum of five per facet in order to obtain facets as balanced as possible (Ziegler, 2014). This selection was done based on item content and pattern of the factor loading matrix. CFAs were fitted using WLSMV (Weighted Least Squares adjusted for Means and Variances) for ordered indicators due to floor and ceiling effects on some item’s response distribution. Model fit was determined based on the usual goodness-of-fit indicators.

##### Exploratory Structural Equation Modelling (ESEM)

In a third step with the second subsample, the higher order structure of the facets was tested with ESEM (Asparouhov & Muthén, 2009). ESEM was the preferred procedure as it allows to relax the too strict independent clusters model in which CFA is usually performed (Marsh et al., 2010), accommodating personality data more realistically. As a control mechanism for content-validity, we eliminated any facet with non-significant loadings from its intended domain. The ESEM model was fitted using geomin oblique rotation and ML estimation.

##### Nomological network

In order to examine evidence of construct validity of our proposed facet model, a nomological network linking our constructs with external outcomes has been build. This network has been constructed by examining associations with a set of linear models and zero-order correlations, again with subsample 2. Pearson correlations were calculated for each outcome with both facets and domains’ scores. One linear model per domain and per criteria was fitted, using all facets included in the domains as predictors, but excluding the domain sum-scores. Standardized coefficients for each predictor (β) were reported, as well as the of the overall model -to represent predictions at the domain level.

To guide the interpretation of the nomological network results, a set of hypotheses derived from research summarized in the introduction were investigated:

* H1. SWL will be predicted by facets of Neurocism mimicking NEO-PI-R *depression*, and facets of Extraversion covering *positive emotions*, with a big to moderate effect size, in line with Schimmack et al. (2004). Neuroticism and Extraversion will be most important domains when predicting SWL.
* H2. Conscientiousness will predict academic achievement with a small to moderate effect size. Openness will entail facets with positive effects and facets with negative effects on GPA scores.
* H3. Conscientiousness will yield the strongest associations with abseentism at the domain level, and facets tapping volitional components such as *goal orientation* or *wish to work* will outstand. Some specific facets of openness and of extraversion will also be significantly associated with abseentism. Overall, the facet level will provide a clearer picture to predict academic abseentism from personality than the domain level.

## Results

##### EFA

Exploratory analysis revealed the domains could be structured into eight to eleven narrower constructs. Model fit information for the EFA procedure are presented in *table 1,* as well as Eigenvalues and results from the MAP and PA tests. To ensure the homogeneity of the facets and to reduce the risk of cross domain loadings, items with factor loadings less than .30 and with non-central content to the domain in question were eliminated (John et al., 2014).

Table 2. EFA model fit

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Domain (number of facets according to EFA) | Chi-squared (df) | CFI | RMSEA | SRMR | Eigenvalues | MAP | PA |
| Agreeableness (10) | 6477.67\*\*\* (4363) | 0.837 | 0.039 | 0.034 | 42.99 | 9 | 9 |
| Conscientiousness (10) | 8377.56\*\*\* (5243) | 0.827 | 0.041 | 0.034 | 51.09 | 12 | 9 |
| Extraversion (8) | 4643.64\*\*\* (2620) | 0.837 | 0.046 | 0.036 | 38.25 | 13 | 9 |
| Neuroticism (8) | 9346.97\*\*\* (5987) | 0.836 | 0.039 | 0.034 | 53.50 | 9 | 7 |
| Openness (9) | 8178.52\*\*\* (5142) | 0.824 | 0.040 | 0.036 | 47.41 | 10 | 11 |

Note: \*\*\* means p value < 0.01.

Eight facets were retained for the domain Agreeableness, after two were eliminated due to weak loadings and clusters whose content was elusive. These facets were named *Appreciation*, *Integrity*, *Low competitiveness*, *Readiness to give feedback*, *Search for support*, *Compliance*, *Genuineness,* and *Altruism*.

Conscientiousness consisted of nine facets after one facet with factor loadings below .30 was excluded, these were: *Dominance*, *Persistence*, *Self-discipline*, *Task planning*, *Goal orientation*, *Carefulness*, *Orderliness*, *Wish to work* (to capacity), and *Productivity*.

Extraversion was formed by nine facets. A new facet (*Energy*) was added in order to tap the physical component of Extraversion, which was missing in the eight-facet solution the EFA suggested. These facets were labelled *Sociability*, *Readiness to take risks*, *Wish for affiliation*, *Positive attitude*, *Forcefulness*, *Communicativeness*, *Humor*, *Conviviality,* and *Energy*.

Neuroticism (interpreted here as emotional stability) consisted of seven facets. One facet was dropped due to poor interpretability and was therefore not included in the subsequent analyses. The final set of facets were named *Equanimity*, *Confidence*, *Carefreeness*, *Mental balance*, *Drive*, *Emotional robustness,* and *Self-attention*.

Openness to experience comprised nine facets. One facet was identified as a method factor and eliminated, as it solely contained negatively formulated items and no coherent underlying trait could be identified. Furthermore, an extra facet was added (*Intellect*), as it was not present in the EFA solution and represents a core construct in other important facet models. The final set of facets of the Openness domain were named *Creativity*, *Wish for variety*, *Open-mindedness*, *Interest in reading*, *Aesthetics*, *Wish to analyze*, *Willingness to learn*, *Sensitivity,* and *Intellect.*

### Reliability

Reliability estimates for each of the facets were obtained using and (they can be found in table 3). 95% C.I. estimates of McDonald’s for the domains were: Agreeableness ranged from 0.83 to 0.86, Conscientiousness ranged from 0.86 to 0.88, Opennessranged from 0.91 to 0.92, Emotional Stability ranged from 0.89 to 0.91, Extraversion ranged from 0.88 to 0.90.

### CFA

Confirmatory factor analysis was applied to each of the facets identified in the previous step, using the second American-based sample. All measurement models fitted well, according to goodness-of-fit indices. The fit information of three facets was not available as these models were reflected by only three indicators and therefore saturated (*energy*, *self-attention*, and *intellect*). Goodness of fit estimations for each facet are available in *table 3.* Models with two or zero degrees of freedom indicate that the facets had four or three items respectively, models with five degrees of freedom signal reflective factors with five indicators.

### ESEM

The final ESEM model was constructed after removing four facets that did not significantly load in their intended domain: *sensitivity* (expected to load on openness), *search for support* and *readiness to give feedback* (expected to load on agreeableness), and *readiness to take risks* (expected to load on extraversion). Furthermore, two residuals were allowed to be correlated after inspection of substantious modification indices: Emotional Stability’s facet *drive* was correlated with Conscientiousness’ facet *persistence*, as well as Extraversion’s facet *forcefulness* with Conscientiousness’ facet *dominance*. The addition of these correlated residuals was consistent with the facet’s content and revealed that a significant amount of specific variance was still present in the facets. The resulting model comprised 38 facets, all of them with significant loadings in their intended domains. It yielded a model fit of Chisq(df) = 1614.8 (521), CFI = .83, RMSEA = .074, SRMR = .043. We consider that this model fitted approximately to our data according to both RMSEA and SRMS, which indicate that the size of the residuals was not substantial. The CFI value was lower than the usual cut-offs, probably due to facet specific variance which was not accounted for in the model. The standardized loadings of the facets in their intended domain can be found in *table 3*, the full factor-loading matrix of the ESEM model can be found in the supplemental materials. As it is usual in ESEM procedures, some facets presented significant cross-loadings in other domains. Specifically, 57 facets had significant cross-loadings, which in sum represent 37.5% of the possible number of cross-loadings. These significant cross loadings ranged from λ= 0.12 to λ= 0.68.

Table 3. Internal consistency, CFA model fit, and ESEM standardized loadings in the intended domain

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | IC | | CFA | | | | ESEM |
|  |  | α | ω | chisq | pvalue | CFI | RMSEA | λ std\* |
| Agreebleness | |  |  |  |  |  |  |  |
|  | Appreciation | 0.71 | 0.73 | 15.02(5) | 0.01 | 0.99 | 0.08 | 0.38 |
|  | Integrity | 0.72 | 0.74 | 3.17(5) | 0.67 | 1 | 0 | 0.64 |
|  | Low competitiveness | 0.72 | 0.72 | 1.99(5) | 0.85 | 1 | 0 | 0.76 |
|  | Good Fatih | 0.65 | 0.69 | 33.59(5) | 0 | 0.97 | 0.13 | 0.23 |
|  | Genuineness | 0.65 | 0.68 | 5.5(5) | 0.36 | 1 | 0.02 | 0.64 |
|  | Altruism | 0.52 | 0.56 | 0.37(2) | 0.83 | 1 | 0 | 0.35 |
| Conscientiousness | |  |  |  |  |  |  |  |
|  | Dominance | 0.71 | 0.73 | 38.45(5) | 0 | 0.93 | 0.14 | 0.27 |
|  | Persistence | 0.57 | 0.62 | 19.72(5) | 0 | 0.98 | 0.09 | 0.32 |
|  | Self-discipline | 0.68 | 0.68 | 13.62(5) | 0.02 | 0.98 | 0.07 | 0.3 |
|  | Task planning | 0.81 | 0.81 | 5.66(5) | 0.34 | 1 | 0.02 | 0.82 |
|  | Goal orientation | 0.77 | 0.77 | 13.6(5) | 0.02 | 0.99 | 0.07 | 0.68 |
|  | Carefulness | 0.68 | 0.68 | 12.94(5) | 0.02 | 0.98 | 0.07 | 0.58 |
|  | Orderliness | 0.82 | 0.83 | 25.64(5) | 0 | 0.99 | 0.11 | 0.46 |
|  | Wish to work to capacity | 0.63 | 0.67 | 10.41(5) | 0.06 | 0.99 | 0.06 | 0.35 |
|  | Productivity | 0.68 | 0.69 | 12.17(5) | 0.03 | 0.98 | 0.06 | 0.4 |
| Extraversion | |  |  |  |  |  |  |  |
|  | Sociability | 0.66 | 0.68 | 13.27(5) | 0.02 | 0.99 | 0.07 | 0.75 |
|  | Wish for affiliation | 0.65 | 0.68 | 16.52(5) | 0.01 | 0.98 | 0.08 | 0.69 |
|  | Positive attitude | 0.82 | 0.83 | 1.75(5) | 0.88 | 1 | 0 | 0.55 |
|  | Forcefulness | 0.68 | 0.7 | 20.94(5) | 0 | 0.97 | 0.09 | 0.2 |
|  | Communicativeness | 0.75 | 0.75 | 18.27(5) | 0 | 0.98 | 0.09 | 0.7 |
|  | Humor | 0.79 | 0.79 | 18.77(5) | 0 | 0.99 | 0.09 | 0.29 |
|  | Conviviality | 0.69 | 0.71 | 14.89(5) | 0.01 | 0.98 | 0.07 | 0.74 |
|  | Energy | 0.71 | 0.74 | 0(0) | 0 | 1 | 0 | 0.49 |
| Neuroticism | |  |  |  |  |  |  |  |
|  | Equanimity | 0.74 | 0.75 | 9.38(5) | 0.09 | 1 | 0.05 | 0.39 |
|  | Mental balance | 0.86 | 0.86 | 10.02(5) | 0.07 | 0.99 | 0.05 | 0.54 |
|  | Carefreeness | 0.77 | 0.77 | 8.46(5) | 0.13 | 1 | 0.04 | 0.76 |
|  | Confidence | 0.7 | 0.71 | 8.2(5) | 0.15 | 1 | 0.04 | 0.41 |
|  | Drive | 0.62 | 0.64 | 13.21(5) | 0.02 | 0.98 | 0.07 | 0.59 |
|  | Emotional robustness | 0.75 | 0.76 | 13.6(5) | 0.02 | 0.99 | 0.07 | 0.73 |
|  | Self-attention | 0.6 | 0.63 | 0(0) | 0 | 1 | 0 | 0.63 |
| Openness | |  |  |  |  |  |  |  |
|  | Creativity | 0.68 | 0.68 | 17.19(5) | 0 | 0.98 | 0.08 | 0.81 |
|  | Wish for variety | 0.70 | 0.72 | 9.96(5) | 0.08 | 1 | 0.05 | 0.42 |
|  | Open-mindedness | 0.66 | 0.67 | 19.17(5) | 0 | 0.98 | 0.09 | 0.77 |
|  | Interest in reading | 0.85 | 0.86 | 5.79(5) | 0.33 | 1 | 0.02 | 0.54 |
|  | Artistic interests | 0.81 | 0.82 | 18.32(5) | 0 | 0.99 | 0.09 | 0.59 |
|  | Wish to analyze | 0.78 | 0.79 | 11.04(5) | 0.05 | 0.99 | 0.06 | 0.78 |
|  | Willingness to learn | 0.81 | 0.82 | 8.03(5) | 0.15 | 1 | 0.04 | 0.71 |
|  | Intellect | 0.8 | 0.81 | 0(0) | 0 | 1 | 0 | 0.62 |

Note: IC = Internal Consistency. “\*” = all factor loadings are significant with p < 0.05.

### Nomological network

A nomological network with our proposed set of facets and three external criteria was built in order to retrieve evidence of criterion validity. This network was performed with both zero-order correlations and linear models, as described in the method section. *Table 4* summarizes these findings and highlights that, overall, the hypotheses outlined in the methods section could be accepted. H1 stated that neuroticism and extraversion should be the domains which had bigger associations with SWL. Indeed, both domains showed the highest correlations and their models accounted for the most variance explained by the predictors. At the facet level, *mental balance* and *positive attitude* (both β > 0.5) best predicted the criterion, also in line with what was hypothesized in H1. H2 stated that conscientiousness would predict GPA with a medium to small effect size and that openness would yield a mixed pattern of association at the facet level. Conscientiousness was, in line with previous research, the domain with higher associations on SWL, with a correlation of *r* = 0.26. Three openness facets significantly predicted the outcome, creativity predicted it inversely (β = -0.14), while interest in reading and intellect predicted it directly (β = 0.12 and 0.17). Thus, our nomological network showed the expected properties regarding H2. H3 stated that conscientiousness should be the domain yielding highest associations with abseentism, and that conscientiousness’ facets related to volitional aspects would highlight this association. Indeed, conscientiousness had the strongest associations with abseentism (in an inverse relation, *r* = -0.28), and two facets related to volition, *task-planning* and *productivity*, were significant predictors of this outcome. Furthermore, H3 stated that the relation of abseentism with other domains will be clearer at the facet level. In this line, we have only found modest associations at the domain level, but some facets like *genuineness*, *energy*, *willingness to learn*, *humor* or *drive* did predict the outcome significantly, thereby confirming H3.

Table 4. Nomological network

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Satisfaction with life | | | | | GPA | | | | | | Absences | | | | | |
|  |  | *r* | stdβ | |  | | *r* | | stdβ | |  | | *r* | | stdβ | |  | |
|  | Appreciation | 0.16 | -0.01 | |  | | 0.12 | | -0.03 | |  | | -0.07 | | 0.02 | |  | |
|  | Integrity | 0.19 | 0.14\* | |  | | 0.17 | | 0.1 | |  | | -0.11 | | -0.01 | |  | |
|  | Low competitiveness | 0.03 | -0.09 | |  | | 0.02 | | -0.13\* | |  | | -0.05 | | 0.04 | |  | |
|  | Good faith | 0.25 | 0.2\* | |  | | 0.17 | | 0.11\* | |  | | -0.11 | | -0.08 | |  | |
|  | Genuineness | 0.12 | 0.04 | |  | | 0.16 | | 0.14\* | |  | | -0.15 | | -0.15\* | |  | |
|  | Altruism | 0.14 | 0.02 | |  | | 0.15 | | 0.07 | |  | | -0.09 | | -0.03 | |  | |
| Agreeableness | | 0.16 |  | 0.08 | | 0.2 | |  | | 0.06 | | -0.14 | |  | | 0.03 | |
|  | Dominance | 0.03 | 0.02 | |  | | 0.06 | | 0.06 | |  | | 0.03 | | 0.04 | |  | |
|  | Persistence | 0.27 | 0.16\* | |  | | 0.12 | | -0.01 | |  | | -0.16 | | 0 | |  | |
|  | Self-discipline | 0.19 | 0.08 | |  | | 0.13 | | 0.07 | |  | | -0.2 | | -0.09 | |  | |
|  | Task planning | 0.2 | 0.01 | |  | | 0.16 | | -0.01 | |  | | -0.25 | | -0.14\* | |  | |
|  | Goal-orientation | 0.28 | 0.13 | |  | | 0.22 | | 0.15\* | |  | | -0.24 | | -0.08 | |  | |
|  | Carefulness | 0.23 | 0.1 | |  | | 0.16 | | 0.03 | |  | | -0.17 | | 0.03 | |  | |
|  | Orderliness | 0.11 | -0.07 | |  | | 0.14 | | 0.06 | |  | | -0.2 | | -0.05 | |  | |
|  | Wish to work | 0.1 | -0.05 | |  | | 0.11 | | 0.03 | |  | | -0.09 | | 0.03 | |  | |
|  | Productivity | 0.23 | 0.07 | |  | | 0.13 | | 0 | |  | | -0.24 | | -0.13\* | |  | |
| Conscientiousness | | 0.3 |  | | 0.13 | | 0.23 | |  | | 0.06 | | -0.28 | |  | | 0.1 | |
|  | Sociability | 0.26 | 0.09 | |  | | 0.11 | | 0.11 | |  | | -0.03 | | -0.04 | |  | |
|  | Wish for affiliation | 0.2 | 0.06 | |  | | 0.06 | | 0 | |  | | 0.01 | | 0.07 | |  | |
|  | Positive attitude | 0.49 | 0.52\* | |  | | 0.07 | | 0.03 | |  | | -0.07 | | -0.07 | |  | |
|  | Forcefulness | 0.09 | -0.03 | |  | | 0 | | -0.05 | |  | | 0.06 | | 0.07 | |  | |
|  | Communicativeness | 0.11 | -0.05 | |  | | 0.06 | | 0.03 | |  | | 0.02 | | -0.01 | |  | |
|  | Humor | 0.16 | -0.07 | |  | | 0.02 | | -0.02 | |  | | 0.08 | | 0.13\* | |  | |
|  | Conviviality | 0.22 | -0.06 | |  | | 0.05 | | -0.01 | |  | | -0.01 | | 0.01 | |  | |
|  | Energy | 0.25 | 0.02 | |  | | 0.06 | | 0.02 | |  | | -0.15 | | -0.18\* | |  | |
| Extraversion | | 0.33 |  | | 0.26 | | 0.05 | |  | | 0.02 | | 0.02 | |  | | 0.05 | |
|  | Equanimity | 0.22 | 0.02 | |  | | 0.11 | | 0.13\* | |  | | -0.11 | | -0.09 | |  | |
|  | Mental balance | 0.53 | 0.59\* | |  | | 0.09 | | 0.13 | |  | | -0.11 | | -0.08 | |  | |
|  | Carefreeness | 0.31 | -0.04 | |  | | -0.01 | | -0.11 | |  | | -0.04 | | 0.09 | |  | |
|  | Confidence | 0.25 | 0.09\* | |  | | 0.03 | | 0.02 | |  | | -0.02 | | 0.04 | |  | |
|  | Drive | 0.27 | -0.05 | |  | | 0.08 | | 0.06 | |  | | -0.15 | | -0.14\* | |  | |
|  | Emotional robustness | 0.18 | -0.07 | |  | | -0.05 | | -0.11 | |  | | -0.01 | | 0.04 | |  | |
|  | Self-attention | 0.21 | -0.04 | |  | | 0 | | -0.03 | |  | | -0.06 | | -0.01 | |  | |
| Neuroticism | | 0.4 |  | | 0.3 | | 0.05 | |  | | 0.04 | | -0.1 | |  | | 0.04 | |
|  | Creativity | 0.06 | -0.1 | |  | | -0.01 | | -0.14\* | |  | | 0 | | 0.03 | |  | |
|  | Wish for variety | 0.18 | 0.09 | |  | | 0.09 | | 0.06 | |  | | 0.01 | | 0.07 | |  | |
|  | Open-mindedness | 0.22 | 0.14\* | |  | | 0.14 | | 0.08 | |  | | -0.07 | | -0.07 | |  | |
|  | Interest in reading | 0.07 | -0.02 | |  | | 0.15 | | 0.12\* | |  | | -0.04 | | -0.04 | |  | |
|  | Artistic Interests | 0.04 | -0.09 | |  | | 0.04 | | -0.06 | |  | | 0.04 | | 0.09 | |  | |
|  | Wish to analyze | 0.13 | -0.05 | |  | | 0.1 | | 0.01 | |  | | 0.01 | | 0.11 | |  | |
|  | Willingness to learn | 0.21 | 0.13 | |  | | 0.1 | | -0.04 | |  | | -0.08 | | -0.15\* | |  | |
|  | Intellect | 0.24 | 0.16\* | |  | | 0.2 | | 0.17\* | |  | | -0.09 | | -0.08 | |  | |
| Openness | | 0.2 |  | | 0.09 | | 0.15 | |  | | 0.07 | | -0.03 | |  | | 0.03 | |

Note: \* means significant at alpha = 0.01. For the column, \* means p < 0.01 in the linear regression’s F statistic.

## Study 2

### Participants

Study two was conducted with an independent sample of 387 German speakers (49.10% male) with a mean age of 45.60 years (SD = 17.50), representative for the German working population with regard to age, gender, and education level. The data was collected in a test center.

### Measures

For the German version of the presented tool, the IPIP items selected in Study 1 were translated and back-translated by bilingual experts. Non-matching back-translations were flagged as inadequate and were further adapted by the same experts. The translated items can be found in the supplemental materials.

### Procedure

#### Measurement invariance (MI) at the facet level

An MI test was conducted to each of the proposed facet models in order to test the equivalence of the fitted models in the German sample. In order to do so, models were first fitted with the German dataset and secondly with both datasets using multigroup constraints. The MI test is used to measure the extent to which different populations’ parameters share the same values across samples. Three levels of MI are analyzed here. First, configural invariance is tested to measure whether the selected items are indicators of the same latent models. Second, metric invariance tests whether the factor loadings of these indicators are similar among the samples. Third, scalar invariance tests whether the intercepts of these indicators are equivalent between samples. The Chi squared difference test (a.k.a. likelihood ratio test) for nested models is used alongside the usual change of goodness-of-fit indices to test MI. Following guidelines provided by Chen (2005), metric invariance is accepted whenever CFI < .01, RMSEA < .015 and SRMR < .03; and scalar invariance whenever CFI < .01, RMSEA < .015, SRMR < .01.

#### MI of the full model

An ESEM model was used to integrate the facet models and inspect its adequacy to convey the Big Five framework, similarly to the procedure used in study 1. First, the configural ESEM model was fitted using the German sample to inspect goodness-of-fit and to test whether all facets loaded significantly in their intended domains. Secondly, the MI approach described above was performed with the ESEM model in order to test the equivalence of both samples when modelling the Big Five domains.

### Results

### MI at the facet level

The laxest level of invariance (i.e. configural invariance), was found in all facet models. However, for 47% of the facets, this was the highest degree of invariance obtained. Furthermore, 19 facets did meet the requirements for metric invariance (50% of the total number of facets), these were *Integrity*, *Compliance* (facets of Agreeableness), *Dominance*, *Self-Discipline,* *Carefulness*, *Orderliness* (facets of Conscientiousness), *Readiness to take risks, Wish for affiliation*, *Positive attitude*, *Humor, Communicativeness* (facets of Extraversion), *Confidence,* *Carefreeness*, *Mental balance*, *Drive*, *Emotional robustness* (facets of Emotional Stability), *Interest in reading*, *Aesthetics* and *Wish to analyze* (facets of Openness). One facet, *sociability* (a facet of extraversion), was scalar invariant.

Summarizing these results within domains, emotional stability had the highest proportion of facets with at least metric invariance (71%), followed by extraversion (63%). The domains which had the smaller proportion of facets meeting requirements of metric invariance were agreeableness (33%), followed by openness (38%) and conscientiousness (44%).

Table 6. Metric invariance

|  |  |  |  |
| --- | --- | --- | --- |
| Domain | Configural MI | Factorial MI | Strong Factorial MI |
|  |  |  |  |
| Agreeableness | Appreciation | Integrity |  |
|  | Low Competitiveness | Compliance |  |
|  | Genuineness |  |  |
|  | Altruism |  |  |
|  |  |  |  |
| Conscientiousness | Persistence | Dominance |  |
|  | Task planning | Self-discipline |  |
|  | Goal-orientation | Carefulness |  |
|  | Wish to work | Orderliness |  |
|  | Productivity |  |  |
|  |  |  |  |
| Extraversion | Forcefulness |  | Sociability |
|  | Energy | Wish for affiliation |  |
|  | Conviviality | Positive attitude |  |
|  |  | Humor  Communicativeness |  |
|  |  |  |  |
| Emotional Stability | Equanimity | Confidence |  |
|  | Self attention | Carefreeness |  |
|  |  | Mental balance |  |
|  |  | Drive |  |
|  |  | Emotional robustness |  |
|  |  |  |  |
| Openness to Experience | Creativity | Interest in reading |  |
|  | Wish for variety | Aesthetics |  |
|  | Open-mindedness | Wish to analyze |  |
|  | Willingness to learn |  |  |
|  |  |  |  |
|  | Intellect |  |  |

### MI of the full model

The ESEM model presented in study 1 (in which we excluded four facets due to non-significant loadings in their intended domains) was fitted in study 2 in two stages, first using only the German sample and then following the MI approach with constraints for multiple groups. The ESEM model with the German sample showed similar fit as with the American sample (Chisq (df) = 1386 (521), CFI = 885, RMSEA = 0.068, SRMR = 0.035). Importantly, all facets loaded significantly in their intended domains, replicating the results of study 1. The MI approach revealed that configural invariance was tenable in the integrated model (Chisq (df) = 3001(1042), CFI = 0.86, RMSEA = 0.071, SRMR = 0.04). Metric invariance was not obtained, as differences in CFI were higher than 0.01 (deltaCFI = 0.026).

# Discussion

The personality test presented herein, named Berlin multi-facetted personality inventory, was developed to cover the need for a tool which maximized the coverage of facets within the Big Five framework. Starting from a large online item pool, we have developed a questionnaire which assesses 38 facets with 202 items. The selected facets cover both central constructs which are present in most Big Five models that include facet levels, as well as more peripheral constructs which could help to describe individual differences in a more nuanced manner. The first evidence of reliability, construct and predictive validity of the set of facets has been promising, according to the results presented in this manuscript. In addition, the Berlin Multi-facet has been developed to enable cross-cultural usage and to align with the principles of open accessibility, ensuring that worldwide researchers and practitioners can benefit from this advance. The following section discusses the proposed facet structure in the context of a multiplicity of proposals including narrow constructs below the Big Five umbrella. It also provides an interpretation of the results exploring its psychometrical properties in comparison with other Big Five inventories, summarizes the association of these facets with some external constructs and elaborates on the possibility to use this tool in international contexts.

### Facet Structure

The instrument presented in this work covers all the “core” facets proposed by Soto and John (2009). In some cases, these core constructs have been labelled similarly to the proposal of the cited authors, that is the case of *energy*, *altruism*, *compliance, order* or *self-discipline*. In some other cases, our proposed labels were different as these were defined more narrowly than in Soto and John (2009). That is the case of *mental balance* (instead of *anxiety*), *emotional robustness* (*depression*), or *artistic interest* (aesthetics). In the remainder of cases, the core constructs were represented by more than a single facet, to account for nuances in facets that we believe are more heterogeneous. This is the case of *low competitiveness* and *integrity*, which both can be thought as related to *assertiveness*; or *open-mindedness* and *wish to analyze*, which are tapping the *ideas* component of the Openness domain.

We advocate that such detailed clustering enforces personality assessment to operate in a more judicious perspective. Hence our inventory does not only cover core facets, but also “peripheral” constructs whose importance may be conditional to the application setting for which the assessment is being conducted. The component of *self-attention* in emotional stability, *altruism* in agreeableness, or *willingness to learn* in openness are good examples of these peripheral facets. Although all of them can be found distributed in different personality inventories, to our knowledge there is no any single inventory that captures this number of different nuances in a single run.

### Psychometric properties

After defining the facet structure with an independent sample, we’ve tested the psychometric properties of the proposed inventory in terms of internal consistency, construct validity and structural validity.

For each of the 38 facets proposed here, we’ve calculated both Cronbach’s alpha and McDonald’s omega as measures of reliability. Although the assumptions in which Cronbach’s alpha are violated in our facet models (especially the assumption of tau-equivalent measures, Viladrich et al., xxx), we’ve reported these estimations in the results section to ease comparability, as alpha is the most common estimator of internal consistency in psychological assessment reports. We’ve found good properties of internal consistency, with 67% of the facets ω greater than 0.70 and 95% of the facets ω > 0.60. The domains were also reliably measured, with ω ranging from 0.83 to 0.92.

Construct validity was assessed by fitting a CFA to each of the facets. Goodness of fit measures signaled that the data is consistent with the facet models, with 88% of the chi-square tests yielding non-significant results and all facets at least approximately fitting the data according to goodness-of-fit indices. These results suggest that the facets included in the Berlin multi-facet personality inventory can be used independently, in case that researchers and practitioners are more interested in a specific set of facets rather than in the full Big Five picture.

These facet models were integrated into the Big Five framework to test their higher order structure. This was performed with ESEM, a method which allows to overcome the constraint of independent clusters solution usually imposed in a CFA. Although some researchers could argue that such constraint is beneficial to ensure a high degree of discriminant validity in the instrument, the independent cluster solution may be too strict to model constructs that are highly inter-related, as it occurs in personality traits. The ESEM helps to overcome this hard constraint by allowing cross-loadings of indicators into latent factors which are not their primary source of variance. A control measure to deduce a reasonable degree of congruent and discriminant validity in the ESEM solution is to verify that the primary factor loadings are distinct from zero (i.e. that they are statistically significant), and that the proportion of significant cross-loadings is not excessive.

### Association with external constructs

We have tested different hypotheses which aimed to replicate previous findings on the interplay between personality and SWL, academic performance and school absenteeism. Overall, the instrument presented here has shown at least a similar predictive ability as other personality instruments. Our first hypothesis stated that SWL would be predicted with a moderate to big effect size by facets which could mimic NEO-Pi-R’s *Cheerfulness* and *Depression*. Confirming this hypothesis, we found positive attitude (which is similar to cheerfulness) and mental balance (akin the inverse of depression) did predict the outcome with a medium effect size (β = .51 and β = .59, respectively). Neuroticism and Extraversion were, as expected, the domains which showed the strongest links to SWL. The other domains did not account for a big piece of variance of SWL ( ranging from 0.08 and 0.13), although we did find some interesting associations at the facet level. For instance, *integrity*, *good faith*, *persistence*, *confidence*, *open-mindedness* and *intellect* did predict SWL significantly, highlighting the usefulness of a rich set of facets when inspecting associations with external outcomes.

Our second hypothesis stated that Conscientiousness would predict academic achievement with a small to moderate effect size, and that Openness would result in a heterogeneous structure of direct and inverse effects at the facet level. Our results were in line with the hypothesis. Conscientiousness’ sum score yielded a correlation of r = .23 with high school GPA, while at the facet level *goal orientation* (β = .15) was the only construct predicting the outcome. Openness was also related to GPA, and as hypothesized some facets were positively related to academic achievement *(Interest in Reading*, β = .12; *Intellect*, β = .17), while some others were related negatively (*Creativity*, β = -.14). Furthermore, two facets of agreeableness did predict high school GPA, they were *low competitiveness* (β = -.13) and *genuineness* (β = .14). The last facet that predicted the outcome was Emotional Stability’s *equanimity* (β = .13).

The third hypothesis stated domains wouldn’t predict abseentism in high school, but that some facets would picture this association more clearly. In line with this hypothesis, all the of the models were very modest ( ranging from 0.03 to 0.1), but some specific facets did predict significantly the outcome. These were Agreeableness’ *genuineness* (β = -.15), Conscientiousness’ *task planning* (β = -.14) and *productivity* (β = -.13), Extraversion’s *energy* (β = -.18) and *humor* (β = .13), Emotional Stability’s *drive* (β = -.14), and Openness’ *willingness to learn* (β = -.15). These results highlight that, in order to better predict educational abseentism, researchers should focus on narrow constructs instead of focusing on broader domains.

All in all, our nomological network sustains a reasonable degree of construct validity for the Berlin Multi-facetted personality inventory. All our hypotheses were approved at the light of our data, and the predictive power of our inventory is very similar to the reported associations between other inventories and external criteria (see *table 1*)*.* Furthermore, our nomological network suggest that switching the focus from a domain perspective towards a facet perspective may increase the strength of associations between personality and external criteria.

### International usage

This instrument aims to be usable in different countries to promote internationalization of individual differences research. To this aim, it has been tested in two different languages, with samples gathered from two countries in two different continents. We have applied measurement invariance techniques to test the extent to which both versions of the inventory are equivalent. At the facet level, all of the facets were configural invariant, and about half of the facets were metric invariant. Strong factorial invariance was attained in one facet. At the domain level, the integration using ESEM has shown configural equivalence. Up to date, the ESEM method still does not support the use of partial invariance, which would be desirable here as full metric invariance was not tenable. Nonetheless, it is important to notice here that the two populations were very different in terms of age (effect size of the difference *d* = 1.83). Given that personality traits’ structure and mean level change within the lifespan of individuals, the effect of age may posit a counterfactual on the true difference between both version’s measurement equivalence. Taking this into account, the degree of measurement invariance obtained by both versions has been satisfying, hence enabling cross-cultural research.

### Theoretical and Practical Implications

Using a broader set of facets to assess personality can have important implications in different research and applied settings. As we have introduced during this manuscript, there is a growing line of research that uses facets as means to predict external outcomes with a higher degree of specificity. However, the debate of whether facets increase the predictive validity of personality attributes to consequential outcomes is lively and a consensus has not been stablished. An extensive facet inventory like the Berlin Multi-Facet could represent a milestone in this debate from which clearer empirical evidence could be collected.

Moreover, different ways of studying the interplay of personality indicators are also on the rise. One such method uses network approaches to explore the association of indicators between themselves and towards external outcomes (Borsboom, xxxx). This approach has been regarded as opposed to common factor methods, such as factor analysis, in which latent factors represent causal precedents of the observed indicators. In recent advances of this methodology, a hybrid solution has been proposed by applying a network structure on top of a common factor model (Epskamp, xxxx). We advocate that extensive facet models such as the Berlin Multi-facet could be extremely useful in applications of this approach, as it would produce a rich set of robust factors (in this vein, nodes) forming an abundant basis for the study of personality networks.

From an applied perspective, having access to a personality inventory which is extensive at the facet level may be extremely helpful. Quite often, practitioners need to adapt new measures without the needed resources to test its robustness, or to apply tools which were not specifically designed for the context in which they are working. This test’s structural validity has been proved both in integration with the Big Five framework and individually on each facet model, hence ensuring that in case that a smaller set of facets is more appropriate to a certain applied setting it could be used without concerns on its psychometric properties. An extensive inventory thus provides greater chances of adaptability to different situational contexts.

### Limitations

Given that this study is the first outlet using the Berlin multi-facet personality inventory, its psychometric properties are still preliminary and subject to be replicated. More studies are needed with heterogeneous samples to test whether the found structure can be retrieved from other populations. We should bear in mind that some facets which were a priori defined had to be excluded from the final proposal due to deficits in their integration with the Big Five framework, this problem could raise again in forthcoming applications.

One important limitation was that, due to the limited sample size that we had available, the ESEM models could not be fitted using a second order structure. Instead, we were forced to use the factor scores from previous facet models as indicators of the domains, as the model did not converge otherwise. By doing so, we had some specific facet variance left outside the ESEM model which resulted in lowered values for the CFI.

Currently, the Berlin multi-facetted personality inventory is only available in two languages. We hope to see a bigger dissemination through different cultures in order to extent its international usability. Although personality traits seem to be universal, a certain degree of cultural variation does exist. Further adaptations of this inventory will reveal the extent to which the chosen indicators relate to the proposed set of facets in countries distinct from the USA or Germany.

### Conclusion

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1. Often the terms are even used synonymously, which is why we will refer to the Big Five from here on. [↑](#footnote-ref-1)