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

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Abstract

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# 1. Introduction

Over the last decades, the Five Factor (Costa & McCrae, 1992) as well as the Big Five (Goldberg, 1990; Digman, 1990) model have become widely accepted models for describing general attributes of personality[[1]](#footnote-1). In both cases, personality is conceptualized in 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 broadest differences in temperament and character (dimensions), through a varying number of mid-level personality characteristics (facets). Most of the research concerning criterion validity of scores derived from Big Five inventories has focused on the covariation between the Big Five dimensions and relevant external outcomes. However, specific dispositional characteristics captured on the facet level might be of extreme utility to provide more complex descriptions of individuality and to predict life outcomes to a major extent (O. P. John et al., 2014; Lounsbury, Sundstrom, Loveland, & Gibson, 2002; Paunonen & Ashton, 2001; Ziegler et al., 2014; Ziegler, Danay, Schölmerich, & Bühner, 2010). 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 (Goldberg, 1999). 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 for 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. Different Facet Structure Models

There are a number of models that include a facet structure below the five broad domains. Probably the most widely known model is the one suggested by Costa and McCrae (1995), the NEO-PI-R model. Other popular models have been suggested for the Big Five Inventory 2 (BFI-2; Soto & John, 2016), the IPIP (Goldberg et al., 2006), and the HEXACO model (K. Lee & Ashton, 2016), which assumes six broad domains. *Table 1* gives an overview of these different models listing the hypothesized facets per dimension as well as some information regarding the psychometric properties of the corresponding scores. Other inventories have been developed, such as the Faceted Inventory of the Five-Factor Model by Watson, Nus, & Wu (2017), not listed in *Table 1*.

Table 1. Most common Big Five models

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Taxonomy | Domains | Facets | Reliability | Validity /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 | 0,7 |  |  |  |  |  |
|  |  | Anxiety | 0,64 |  |  |  |  |  |
|  |  | Dependence | 0,8 |  |  |  |  |  |
|  |  | Sentimentality | 0,7 | - 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 | 0,7 | + 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 | 0,7 | + 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 | 0,8 |  |  |  |  |  |
|  |  | 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 | 0,8 | + 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 | 0,7 | - 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 | 0,8 | + Addictive mobile phone  usage style **(**.28**)** (Siddiqui, 2011) |  |  |  |  |
|  | Openness to Experience |  |  |  |  |  |  |  |
|  |  | Imagination | 0,83 |  |  |  |  |  |
|  |  | Artistic interests | 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 | 0,8 | + Academic Performance **(**.23**)**  (Rosander, Bäckström & Sternberg, 2011) |  |  |  |  |
|  |  | Self-Discipline | 0,73 | + General health behaviors (.27)  (Hagger-Johnson & Whiteman, 2007) |  |  |  |  |
|  |  | Cautiousness | 0,87 |  |  |  |  |  |

Note: Reliability estimates (Cronbach’s α) were retrieved from the sources cited in the reliability column. Coefficients in the validity column represents Pearson r. Numbers in the validity column in the initial row represent number of items.

As shown in *Table 1*, there are different suggestions for the number and content of facets forming each domain. Despite these differences, there is still some degree of overlap. C. J. 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 C. J. 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. This convergence also holds for the four instruments listed in *Table 1*, as these ten constructs are covered within the facets for every instrument. Some of the constructs are explicitly covered at the facet level (e.g. Anxiety); meanwhile others are 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 core constructs proposed by C. J. Soto and John (2009). As an example, we find Self-Consciousness, a Neuroticism facet defined by the NEO-PI-R and the IPIP-NEO-120, which is neither tapping Anxiety nor Depression. The same authors asserted in a later work (Soto & John, 2016) that the Big Five dimensions *“can be conceptualized and assessed more broadly or more narrowly”*, either focusing on central facets or on a set of peripheral facets, depending on the research interest. In this project we aimed for an instrument with a large number of facets in order to have both, the core constructs, but also the more peripheral facets. This was done, to cover as much content of each dimension as possible (Ziegler & Bäckström, 2016)

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 C. J. Soto and John’s (2009) and DeYoung et al.’s (2007) proposals have many points in common.

The hierarchical structure underlying the Big Five nomological network can thus be drawn from nuances through facets through aspects to dimensions. However, the aspect level is not covered in most theories. Relying on dimensions to explain and predict behavior can benefit from ease of interpretability. However, the domain itself is way too abstract to really get down to behavioral mechanisms underlying the correlational patterns. Moreover, predictions for specific contexts can be enhanced if a more specific set of traits is used (Ziegler & Brunner, 2016). On the other hand, using nuances to predict behavior might yield even stronger predictive power (Seeboth & Mõttus, 2018), but as the number of predictors grows the interpretation becomes more complex. Facets are on a middle ground between nuances and dimensions, 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.

## 1.3 Facets predict consequential outcomes

**1.3.1 Satisfaction with Life**

Personality facet scores were found to be strong predictors of a diverse set of outcomes. Satisfaction with life (SWL) is one of them. Neuroticism and Extraversion scores were recognized as the most important personality dimension scores 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 score level outperforms the analysis at the domain score level. They observed that scores for *Depression* and *Positive Emotions* / *Cheerfulness* explained SWL scores above and beyond the dimension scores those facets represent. Correlations in the Schimmack et al. (2004) study, derived from longitudinal data, range from *r* = -.57 to *r* = -.49 for *Depression* and from *r* = .51 to *r* = .38 for *Positive Emotions / Cheerfulness*. Thus, we assumed here that…

**1.3.2 Academic Performance**

Another relevant outcome is academic achievement. Conscientiousness has been recognized as the strongest dimension of the Big Five to predict academic achievement. At the facet level De Fruyt and Mervielde (1996) hypothesized that differences in volitional facets of Conscientiousness would be more prone to exhibit strong relations with academic achievement. In line with this idea, there is a collection of research which points at relations of grade point average (GPA) with facet scores 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, also other Conscientiousness facet scores more related to duties or moral have been found to predict GPA: *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 contribute in opposite directions. Paunonen and Ashton (2001) found that the Openness facet score for *Understanding* correlates with academic achievement with *r* = .23. Noftle and Robins (2007) identified a set of NEO-PI-R and HEXACO Openness facet scores 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, O. P. John et al. (2014) found that *Openness to ideas* scores were related positively with work performance, while *Openness to fantasy* scores were related negatively, potentially masking the overall effect of Openness over the working performance criterion. Thus, we assumed here that…

**1.3.3 Academic Absenteeism**

Likewise, personality test scores have been proven to be powerful predictors of work and educational absenteeism (Chamorro-Premuzic & Furnham, 2003; Judge, Martocchio, & Thoresen, 1997; Salgado, 2002). Research has highlighted the predictive power of personality test scores over so-called integrity test scores when predicting absences (Ones, Viswesvaran, & Schmidt, 2003). Again, most research has focused on the domain level, although some researchers suggested that personality assessed at a narrower level would improve the predictive ability of the models (Lounsbury et al., 2004). Lounsbury et al. (2004) found a modest predictive gain of *Work drive* scores over Big Five domain scores.

The question whether narrow measures have a superior predictive power over broad measures when predicting external criteria enjoys a lively debate nowadays. Research summarized in this section suggests an advantage for scores derived from more narrow measures. Nonetheless there is some research pointing at the opposite direction (Salgado, 2017; Chen, 2012). Testing which type of measure best predicts external criteria falls out of the scope of this study. Still, our results will further fuel the debate mentioned.

## This study

The aims of this study were twofold. In a first step, we tried to establish a facet structure below the Big Five dimensions starting from a data base as broad as possible. This research, in a sense, is a continuation of MacCann, Duckworth, and Roberts (2009), in which the authors used data from the International Personality Item Pool (IPIP) to design a measure of Conscientiousness containing the maximum relevant facet scores possible. The same procedure is applied here and some of the same data are used, although for all the Big Five domains. In a second step, we aimed at providing evidence regarding reliability, validity, and measurement invariance for the scores of the newly derived personality inventory.

It has to be stressed that this inventory has been designed to be available for both researchers and practitioners at no cost. The items and keys are available in the Appendix. Moreover, the inventory has been developed for international use. The studies presented here focus on different cultures (American vs. German).

H1. SWL will be best predicted by the facets of Extraversion and Neuroticism.

* + H1.1. Adding the facet scores will significantly improve the predictions of personality on SWL.
  + H1.2. Particularly the facets *Confidence* (N2) and *Positive attitude* (E4) will behave similarly to those reported by Schimmack et al. (2004).
* H2. The conscientiousness score will be the strongest dimension when predicting academic achievement.
  + H2.1. Openness will be related positively but moderately to academic achievement.
  + H2.2. Facet scores will add about 10% of additional explained variance to dimensions when predicting academic achievement
* H3. Facet scores will improve the predictive power of dimensions when predicting school absenteeism.

# Methods

## Study 1 - US-American Sample

### Participants

: The sample consisted of 722 American undergraduate students (59.30% male) who participated voluntarily. The mean age was 21.60 years (SD = 5.90). Students were emailed the 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. In subsample 1 the mean age was 21.80 years (SD= 6.30), in subsample 2 the mean age was 21.50 years (SD=5.60).

## Measures

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

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

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

### Satisfaction With Life (SWL)

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

### GPA

: Participants reported their high school GPA and their current college GPA.

Absences: Absenteeism was rated from teachers in school and in college. Absences were log transformed prior to analyses, following Lounsbury et al. (2004).

## 2.1.3. Procedure

### EFA with subsample 1

: EFAs were conducted for each dimension separately following the Goldberg’s back-assward method. To determine the number of possible facets per domain Velicer’s (1976) Minimum Average Partial (MAP) method and Horn’s (1965) parallel analysis (PA) were utilized for every domain separately. Based on these results a series of Exploratory Factor Analyses (EFA) was calculated for each domain via Mplus (Muthen & Muthen, 20XX) using a geomin rotation and a Maximum Likelihood estimator (ML). The decision for the preferred number of facets per domain was based partly on comparing model fits of different factor solutions (CFI, RMSEA, SRMR). More importantly though was the interpretability of the facet solution. Additionally, facet solutions from other personality measures were considered and compared to the found facet structure. If there were important parts missing to present the domain with regards to content, new items representing the missing facets were added a posteriori.

### CFA and ESEM with subsample 2

: To confirm the structure of facets the EFAs suggested, multiple CFAs were calculated via Mplus using the second part of the data. In a first step, measurement models were estimated for each of the facet scores. To obtain balance between the facet scores, the items were reduced to five per facet based on item content and loading pattern (Ziegler, 2014). The estimator used was WLSMV (Weighted Least Squares adjusted for Means and Variances). In a second step, the estimations for the measurement models of each domain with facet scores as indicators were repeated via CFA using ML. Aim was to ensure an optimal breadth. In a final model, all five domain structural models were integrated using ESEM (Asparouhov & Muthén, 2009). Marsh et al. (2010) could show that ESEM fits personality data better and results in substantially more differentiated factors than CFA. All facets were allowed to load on all dimensions. If a facet score did not load on the intended domain, this facet would get eliminated subsequently. The estimator used was ML, factor scores from the facet CFAs were used as indicators and the rotation was oblique (using Geomin). Model fit was determined based on the guidelines 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

Cronbach’s and McDonald’s will be estimated for each facet score to provide evidence for the test scores’ internal consistency.

### Criterion validity evidence

To examine the nomological structure of the facet scores and dimensions with external constructs a set of linear models and correlations were fitted. Pearson correlation was calculated for each external criteria with each facet score and the domain score. One linear model per dimension and per criteria was fitted, using all facets within the domain as predictors. Betas for each predictor and an overall R square coefficient was calculated from the linear models.

## Results

### Results of EFA

: In *Table 2* model fits for the chosen facet model for each domain are shown, as well as Eigenvalues and results from the MAP test and PA. To ensure the homogeneity of the facets and to reduce the risk of cross domain loadings, items with factor loadings less than .30 and a content that was judged to be non-central to the domain in question (O. P. John et al., 2014) were eliminated.

Table 2. EFA model fits

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Dimensions (number of chosen factes for EFA) | Chi-squared (df) | CFI | RMSEA | SRMR | Eigenvalues | MAP | PA |
| Agreeableness (10) | 6477.67\*\*\* (4363) | 0,837 | 0,039 | 0,034 | 42,99 | 8 | 9 |
| Conscientiousness (10) | 8377.56\*\*\* (5243) | 0,827 | 0,041 | 0,034 | 51,09 | 8 | 10 |
| Extraversion (8) | 4643.64\*\*\* (2620) | 0,837 | 0,046 | 0,036 | 38,25 | 8 | 10 |
| Neuroticism (8) | 9346.97\*\*\* (5987) | 0,836 | 0,039 | 0,034 | 53,5 | 8 | 7 |
| Openness (9) | 8178.52\*\*\* (5142) | 0,824 | 0,04 | 0,036 | 47,41 | 8 | 11 |

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

According to the exploratory model, Agreeableness consists of eight facets after two facets were eliminated due to weakly loading and hard to interpret items. The remaining facets were named *Appreciation*, *Integrity*, *Low competitiveness*, *Readiness to give feedback*, *Search for support*, *Good faith*, *Genuineness,* and *Altruism*.

Conscientiousness consists of nine facets after one facet with item factor loadings less than .30 was excluded, they are: *Dominance*, *Persistence*, *Self-discipline*, *Task planning*, *Goal orientation*, *Carefulness*, *Orderliness*, *Wish to work* (to capacity), and *Productivity*.

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

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

Openness to experience comprises nine facets. One facet was identified as a method factor and eliminated, because it solely contained negatively formulated items and no coherent underlying trait could be identified. Furthermore, another facet (*Intellect*) was added, because the remaining facets lacked an intellectual content. The facets of Openness are named *Creativity*, *Wish for variety*, *Open-mindedness*, *Interest in reading*, *Artistic interests*, *Wish to analyze*, *Willingness to learn*, *Sensitivity,* and *Intellect.*

### Results of CFA and ESEM

All measurement models for the facets fitted well, results are summarized in *Table 3*.

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

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | USA sample | | | | German Sample | | | |
| facets | chisq(df) | p-value | CFI | RMSEA | chisq(df) | p-value | CFI | RMSEA |
| a1 | 7.686(5) | 0.174 | 0.999 | 0.039 | 15.141(5) | 0.01 | 0.99 | 0.072 |
| a2 | 1.677(5) | 0.892 | 1 | 0 | 34.724(5) | < 0.001 | 0.974 | 0.124 |
| a3 | 1.031(5) | 0.96 | 1 | 0 | 28.603(5) | < 0.001 | 0.964 | 0.11 |
| a4 | 6.628(5) | 0.25 | 0.993 | 0.03 | 20.642(5) | < 0.001 | 0.951 | 0.09 |
| a5 | 10.469(5) | 0.063 | 0.986 | 0.055 | 65.262(5) | < 0.001 | 0.882 | 0.176 |
| a6 | 19.051(5) | 0.002 | 0.988 | 0.088 | 15.098(5) | 0.01 | 0.991 | 0.072 |
| a7 | 2.935(5) | 0.71 | 1 | 0 | 29.404(5) | < 0.001 | 0.965 | 0.112 |
| a8 | 0.257(2) | 0.88 | 1 | 0 | 6.636(2) | 0.036 | 0.932 | 0.077 |
| c1 | 24.279(5) | <.001 | 0.968 | 0.103 | 19.883(5) | 0.001 | 0.989 | 0.088 |
| c2 | 12.891(5) | 0.024 | 0.99 | 0.066 | 8.72(5) | 0.121 | 0.995 | 0.044 |
| c3 | 8.415(5) | 0.135 | 0.995 | 0.044 | 36.07(5) | < 0.001 | 0.937 | 0.127 |
| c4 | 2.803(5) | 0.73 | 1 | 0 | 47.719(5) | < 0.001 | 0.977 | 0.149 |
| c5 | 5.805(5) | 0.326 | 1 | 0.021 | 154.106(5) | < 0.001 | 0.909 | 0.278 |
| c6 | 8.102(5) | 0.151 | 0.994 | 0.042 | 18.672(5) | 0.002 | 0.978 | 0.084 |
| c7 | 9.901(5) | 0.078 | 0.998 | 0.052 | 92.76(5) | < 0.001 | 0.954 | 0.213 |
| c8 | 5.998(5) | 0.306 | 0.999 | 0.024 | 35.668(5) | < 0.001 | 0.954 | 0.126 |
| c9 | 8.007(5) | 0.156 | 0.993 | 0.041 | 19.16(5) | 0.002 | 0.979 | 0.086 |
| e1 | 7.139(5) | 0.21 | 0.997 | 0.034 | 6.341(5) | 0.274 | 0.997 | 0.026 |
| e2 | 21.787(5) | 0.001 | 0.985 | 0.097 | 44.117(5) | < 0.001 | 0.966 | 0.142 |
| e3 | 9.454(5) | 0.092 | 0.995 | 0.05 | 50.828(5) | < 0.001 | 0.943 | 0.154 |
| e4 | 0.793(5) | 0.977 | 1 | 0 | 29.172(5) | < 0.001 | 0.989 | 0.112 |
| e5 | 11.069(5) | 0.05 | 0.99 | 0.058 | 6.587(5) | 0.253 | 0.998 | 0.029 |
| e6 | 11.351(5) | 0.045 | 0.991 | 0.059 | 127.563(5) | < 0.001 | 0.883 | 0.252 |
| e7 | 9.437(5) | 0.093 | 0.997 | 0.05 | 28.17(5) | < 0.001 | 0.983 | 0.109 |
| e8 | 8.777(5) | 0.118 | 0.995 | 0.046 | 31.239(5) | < 0.001 | 0.981 | 0.116 |
| e9 | 0(0) | NA | 1 | 0 | 0(0) | < 0.001 | 1 | 0 |
| n1 | 4.999(5) | 0.416 | 1 | 0 | 29.498(5) | < 0.001 | 0.974 | 0.113 |
| n2 | 5.553(5) | 0.352 | 1 | 0.018 | 57.719(5) | < 0.001 | 0.981 | 0.165 |
| n3 | 4.391(5) | 0.495 | 1 | 0 | 14.337(5) | 0.014 | 0.99 | 0.069 |
| n4 | 4.333(5) | 0.503 | 1 | 0 | 43.461(5) | < 0.001 | 0.95 | 0.141 |
| n5 | 8.177(5) | 0.147 | 0.995 | 0.042 | 22.031(5) | < 0.001 | 0.972 | 0.094 |
| n6 | 8.112(5) | 0.15 | 0.996 | 0.042 | 15.515(5) | 0.008 | 0.988 | 0.074 |
| n7 | 0(0) | NA | 1 | 0 | 0(0) | < 0.001 | 1 | 0 |
| o1 | 9.098(5) | 0.105 | 0.996 | 0.048 | 6.403(5) | 0.269 | 0.997 | 0.027 |
| o3 | 10.098(5) | 0.073 | 0.994 | 0.053 | 100.749(5) | < 0.001 | 0.869 | 0.222 |
| o4 | 1.941(5) | 0.857 | 1 | 0 | 17.058(5) | 0.004 | 0.998 | 0.079 |
| o5 | 7.855(5) | 0.164 | 0.999 | 0.04 | 5.175(5) | 0.395 | 1 | 0.01 |
| o6 | 4.815(5) | 0.439 | 1 | 0 | 7.965(5) | 0.158 | 0.998 | 0.039 |
| o7 | 3.399(5) | 0.639 | 1 | 0 | 7.74(5) | 0.171 | 0.999 | 0.038 |
| o8 | 18.101(2) | <.001 | 0.953 | 0.15 | 118.726(2) | < 0.001 | 0.842 | 0.388 |
| o9 | 0(0) | NA | 1 | 0 | 0(0) | < 0.001 | 1 | 0 |

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

< Table 4 here caption=“ESEM factor scores”)>

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Agreeableness | Conscientiousness | Extraversion | Neuroticism | Openness |
| A1 | -0.383\*\*\* | 0.124 | 0.261\*\*\* | 0.095 | 0.446\*\*\* |
| A2 | 0.638\*\*\* | -0.218\* | -0.181\*\* | 0.130 | -0.099 |
| A3 | 0.757\*\*\* | 0.058 | 0.063 | 0.102 | 0.118 |
| A6 | -0.229\*\*\* | 0.007 | 0.407\*\*\* | 0.226\*\* | 0.137 |
| A7 | 0.635\*\*\* | -0.172 | -0.034 | 0.144 | -0.001 |
| A8 | -0.347\*\*\* | -0.003 | 0.246\*\*\* | 0.132 | 0.334\*\*\* |
| C1 | 0.677\*\*\* | 0.273\*\*\* | 0.081 | 0.041 | 0.177 |
| C2 | 0.033 | -0.325\*\* | -0.203\*\* | 0.457\*\*\* | -0.169\* |
| C3 | 0.265\*\*\* | -0.302\* | 0.096 | 0.533\*\*\* | 0.163\* |
| C4 | 0.183\* | 0.816\*\*\* | -0.097 | 0.034 | 0.012 |
| C5 | 0.068 | 0.681\*\*\* | 0.133 | -0.147 | 0.184\* |
| C6 | -0.071 | 0.585\*\*\* | -0.194\* | 0.013 | 0.321\*\*\* |
| C7 | 0.032 | -0.46\*\*\* | 0.045 | 0.364\*\*\* | 0.185\*\* |
| C8 | 0.054 | 0.35\*\*\* | 0.114 | 0.148\* | 0.191\* |
| C9 | 0.12\* | 0.4\*\*\* | 0.077 | -0.24\*\* | 0.16\* |
| E1 | -0.082 | 0.015 | -0.746\*\*\* | 0.025 | -0.002 |
| E3 | 0.045 | 0.078 | -0.694\*\*\* | 0.029 | 0.456\*\*\* |
| E4 | -0.081 | 0.169\* | 0.547\*\*\* | -0.163 | 0.249\*\*\* |
| E5 | 0.6\*\*\* | 0.039 | 0.196\*\*\* | -0.007 | 0.398\*\* |
| E6 | 0.113 | -0.077 | 0.699\*\*\* | 0.36\*\*\* | -0.001 |
| E7 | 0.080 | -0.203\*\* | 0.289\*\*\* | -0.027 | 0.414\*\*\* |
| E8 | 0.048 | 0.012 | 0.744\*\*\* | 0.137 | 0.083 |
| E9 | 0.106 | 0.042 | 0.492\*\*\* | -0.264\*\*\* | 0.110 |
| N1 | 0.46\*\*\* | 0.011 | -0.055 | 0.389\*\*\* | -0.135 |
| N2 | 0.052 | -0.100 | -0.489\*\*\* | 0.54\*\*\* | 0.083 |
| N3 | 0.003 | 0.144 | -0.243\*\* | 0.755\*\*\* | 0.090 |
| N4 | 0.204\* | -0.013 | 0.064 | -0.411\*\*\* | 0.537\*\*\* |
| N5 | 0.027 | -0.365\*\* | -0.234\*\* | 0.587\*\*\* | 0.006 |
| N6 | -0.162 | 0.247\* | 0.055 | 0.729\*\*\* | -0.129 |
| N7 | 0.136\* | 0.106 | 0.009 | 0.629\*\*\* | -0.089 |
| O1 | 0.220 | -0.236\*\*\* | -0.014 | -0.158\*\* | 0.806\*\*\* |
| O2 | -0.184\*\* | 0.121 | 0.284\*\*\* | 0.038 | 0.42\*\*\* |
| O3 | -0.082 | -0.012 | 0.066 | -0.095 | 0.768\*\*\* |
| O4 | -0.208\*\* | -0.040 | -0.173\*\* | 0.107 | 0.543\*\*\* |
| O5 | -0.27\*\* | -0.095 | 0.031 | 0.056 | 0.586\*\*\* |
| O6 | -0.001 | 0.154\* | -0.152\* | 0.065 | 0.776\*\*\* |
| O7 | -0.246\*\* | 0.137\* | 0.044 | -0.050 | 0.706\*\*\* |
| O9 | 0.073 | 0.17\*\* | -0.114 | -0.197\*\*\* | 0.623\*\*\* |

### Reliability

: Reliabilities for the 5 item facet scores were estimated with and . Agreeableness facet scores showed a mean of 0.68, and a mean of 0.69. Conscientiousness’ mean = 0.68, and mean = 0.70. Openness’ mean = 0.76, and mean = 0.77. Neuroticism mean = 0.68, and mean = 0.69. Extraversion’s mean = 0.72, and mean = 0.74.

### Criterion validity evidence

Table 5 summarizes correlations and predictions of the facet scores with external criteria described previously in this work. Low Neuroticism and high Extraversion scores went along with higher SWL scores, in line with the proposed hypothesis. When predicting SWL based on facet scores, Extraversion explained 32.6% of the variability of the factor, and Neuroticism 40.2%.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Life Satisfaction | | | GPA | | | Absences | | |
|  | correlation | beta | R square | correlation | beta | R square | correlation | beta | R square |
| Openness |  |  |  |  |  |  |  |  |  |
| O1 | 0.063 | -0.1 |  | -0.013/0.03 | -0.138/-0.016 |  | 0.012/-0.014 | 0.172/-0.173 |  |
| O2 | 0.176 | 0.076 |  | 0.092/0.011 | 0.047/-0.002 |  | -0.143/0.135 | -0.101/0.097 |  |
| O3 | 0.225 | 0.124 |  | 0.144/0.087 | 0.072/0.182 |  | -0.147/0.142 | -0.104/0.106 |  |
| O4 | 0.072 | -0.023 |  | 0.152/-0.048 | 0.126/-0.107 |  | -0.162/0.156 | -0.128/0.122 |  |
| O5 | 0.039 | -0.098 |  | 0.041/0.107 | -0.069/0.159 |  | -0.068/0.071 | 0.078/-0.064 |  |
| O6 | 0.134 | -0.057 |  | 0.1/0.008 | 0/-0.015 |  | -0.199/0.203 | -0.184/0.206 |  |
| O7 | 0.212 | 0.111 |  | 0.096/-0.037 | -0.052/-0.14 |  | -0.147/0.134 | 0.004/-0.025 |  |
| O8 | 0.176 | 0.122 |  | 0.121/0.039 | 0.1/0.029 |  | -0.09/0.079 | -0.022/0.012 |  |
| O9 | 0.238 | 0.166 |  | 0.203/-0.017 | 0.184/-0.054 |  | -0.078/0.068 | 0.063/-0.073 |  |
| Domain score | 0.2 |  | 0.095 | 0.148/0.031 |  | 0.065/0.026 | -0.171/0.164 |  | 0.069/0.068 |
| Conscientiousness | |  |  |  |  |  |  |  |  |
| C1 | 0.033 | 0.019 |  | 0.061/-0.026 | 0.06/-0.017 |  | -0.011/0.02 | 0.004/0.006 |  |
| C2 | 0.272 | 0.162 |  | 0.115/-0.104 | -0.014/-0.047 |  | 0.074/-0.091 | 0.074/-0.083 |  |
| C3 | 0.194 | 0.08 |  | 0.133/-0.065 | 0.072/-0.051 |  | 0.024/-0.039 | 0.042/-0.042 |  |
| C4 | 0.202 | 0.013 |  | 0.164/-0.068 | -0.009/-0.029 |  | -0.029/0.015 | 0.033/-0.036 |  |
| C5 | 0.283 | 0.129 |  | 0.219/-0.151 | 0.148/-0.203 |  | -0.017/0.001 | -0.038/0.037 |  |
| C6 | 0.233 | 0.101 |  | 0.159/-0.011 | 0.034/0.099 |  | -0.12/0.103 | -0.191/0.181 |  |
| C7 | 0.112 | -0.074 |  | 0.14/-0.013 | 0.061/0.09 |  | 0.023/-0.039 | 0.002/-0.006 |  |
| C8 | 0.101 | -0.045 |  | 0.115/0.021 | 0.027/0.098 |  | 0.002/-0.007 | 0.038/-0.035 |  |
| C9 | 0.231 | 0.073 |  | 0.133/-0.084 | 0.005/-0.028 |  | 0.044/-0.063 | 0.072/-0.082 |  |
| Domain score | 0.303 |  | 0.116 | 0.233/-0.09 |  | 0.048/0.026 | -0.001/-0.019 |  | 0.02/0.021 |
| Extraversion |  |  |  |  |  |  |  |  |  |
| E1 | 0.255 | 0.091 |  | 0.109/0.045 | 0.099/0.06 |  | -0.053/0.036 | -0.004/-0.006 | |
| E2 | -0.003 | -0.035 |  | -0.14/0.082 | -0.174/0.078 |  | 0.107/-0.091 | 0.143/-0.125 |  |
| E3 | 0.2 | 0.06 |  | 0.056/0.002 | 0/-0.005 |  | -0.028/0.003 | 0.006/-0.028 |  |
| E4 | 0.493 | 0.513 |  | 0.065/-0.005 | 0.011/-0.023 |  | -0.038/0.024 | 0.035/-0.045 |  |
| E5 | 0.09 | -0.019 |  | 0.005/0.029 | 0.001/-0.001 |  | -0.007/0.009 | 0.031/-0.028 |  |
| E6 | 0.111 | -0.05 |  | 0.057/-0.01 | 0.037/-0.057 |  | -0.087/0.081 | -0.063/0.065 |  |
| E7 | 0.164 | -0.059 |  | 0.023/0.042 | 0.014/0.026 |  | -0.069/0.065 | -0.084/0.083 |  |
| E8 | 0.222 | -0.06 |  | 0.053/0.042 | -0.007/0.053 |  | -0.104/0.094 | -0.121/0.12 |  |
| E9 | 0.249 | 0.019 |  | 0.059/-0.036 | 0.04/-0.073 |  | 0.024/-0.028 | 0.053/-0.046 |  |
| Domain score | 0.326 |  | 0.254 | 0.05/0.037 | / | 0.028/-0.003 | -0.051/0.039 |  | 0.027/0.021 |
| Agreeableness | |  |  |  |  |  |  |  |  |
| A1 | 0.159 | 0.004 |  | 0.12/-0.028 | -0.034/0.054 |  | -0.09/0.079 | -0.039/0.032 |  |
| A2 | 0.194 | 0.058 |  | 0.168/-0.048 | 0.115/-0.056 |  | -0.087/0.073 | -0.105/0.098 |  |
| A3 | 0.026 | -0.129 |  | 0.015/-0.013 | -0.108/-0.005 |  | 0.034/-0.031 | 0.091/-0.074 |  |
| A4 | -0.05 | -0.079 |  | 0.093/-0.116 | 0.084/-0.13 |  | -0.105/0.108 | -0.102/0.106 |  |
| A5 | -0.179 | -0.163 |  | -0.026/0.024 | -0.017/0.048 |  | -0.021/0.031 | -0.02/0.028 |  |
| A6 | 0.253 | 0.234 |  | 0.168/-0.035 | 0.091/0.037 |  | -0.085/0.073 | -0.025/0.014 |  |
| A7 | 0.123 | 0.059 |  | 0.165/-0.006 | 0.135/0.029 |  | -0.077/0.064 | -0.071/0.057 |  |
| A8 | 0.14 | 0.043 |  | 0.145/-0.126 | 0.058/-0.139 |  | -0.036/0.037 | 0.046/-0.034 |  |
| Domain score | 0.157 |  | 0.104 | 0.201/-0.078 |  | 0.057/0.018 | -0.108/0.1 |  | 0.022/0.017 |
| Neuroticism |  |  |  |  |  |  |  |  |  |
| N1 | 0.225 | 0.023 |  | 0.111/-0.086 | 0.134/-0.134 |  | -0.108/0.091 | -0.186/-0.186 | |
| N2 | 0.531 | 0.591 |  | 0.091/-0.043 | 0.135/-0.114 |  | 0.005/-0.017 | -0.063/-0.063 | |
| N3 | 0.309 | -0.04 |  | -0.012/0.073 | -0.112/0.215 |  | 0.102/-0.116 | 0.198/0.198 |  |
| N4 | 0.25 | 0.093 |  | 0.031/0.006 | 0.016/0.023 |  | -0.034/0.032 | -0.048/-0.048 | |
| N5 | 0.269 | -0.047 |  | 0.079/-0.051 | 0.057/-0.078 |  | -0.005/-0.016 | -0.04/-0.04 |  |
| N6 | 0.176 | -0.074 |  | -0.055/0.028 | -0.109/-0.005 |  | 0.041/-0.041 | 0.005/0.005 |  |
| N7 | 0.206 | -0.038 |  | -0.001/0.041 | -0.034/0.055 |  | 0.095/-0.099 | 0.11/0.11 |  |
| Domain score | 0.401 |  | 0.289 | 0.048/-0.007 |  | 0.03/0.025 | 0.016/-0.03 |  | 0.043/0.043 |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
| Note: scores left of slash represent data from high school, right of slash represent data from college | | | | | | | |  |  |

## Study 2 – German Sample

### Participants

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

### Measures

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

## Procedure

### Step 1 – Examining the structure

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

### Step 2 – Testing for measurement invariance

: In a next step, measurement invariance between German and US samples was examined. We followed the procedure suggested by Sass (2011) and tested configural, factorial and strong factorial invariance. The cutoffs suggested by Chen (2007) were applied to compare model fits. According to this configural measurement invariance can be assumed when the same item is associated with the same factor in each domain, while the factor loadings can differ. If the factor loadings of each item would not differ between the samples, factorial measurement invariance can be assumed. Strong factorial measurement invariance can be assumed when on top of that the intercepts of each item are equal. The limit to factorial measurement invariance was set to CFI < .01, RMSEA < .015 and SRMR < .03, at which the limit to strong factorial measurement invariance was set to CFI < .01, RMSEA < .015, SRMR < .01 as suggested by Chen (2007).

## Results

### Results of CFA

: The measurement models of the American sample were replicated for the reduced number of items per facet. Model fits can also be seen in *Table 3*. The ESEM with all five dimensions showed an acceptable fit to the data with CFI = .82, RMSEA = .078, SRMR = .044. *Table 5* shows the ESEM factor loadings for the German sample. All facets loaded significantly on their intended dimension.



### Results of MI

: For analyzing measurement invariance the latest facet model structure (with additional facets) was taken. The results are shown in Table 6. Configural measurement invariance could be shown for the facets *Appreciation*, *Low Competitiveness*, *Readiness to give feedback*, *Search for support*, *Genuiness*, *Altruism* (facets of Agreeableness), *Persistence*, *Task Planning*, *Goal-orientation*, *Wish to work*, *Productivity* (facets of Conscientiousness), *Forcefulness*, *Energy, Conviviality* (facets of Extraversion), *Equanimity*, *Self-Attention* (facets of Neuroticism), *Creativity*, *Wish for variety*, *Open-mindednes*, *Willingness to learn*, *Sensitivity* and *Intellect* (facets of Openness).

Factorial measurement invariance could be shown for the facets *Integrity*, *Good faith* (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 Neuroticism), *Interest in reading*, *Artistic interest* and *Wish to analyze* (facets of Openness).

The only facet with strong factorial measurement invariance was *Sociability*, a facet of Extraversion.

Table 6. Metric invariance

|  |  |  |  |
| --- | --- | --- | --- |
| Dimension | Configural MI | Factorial MI | Strong Factorial MI |
|  |  |  |  |
| Agreeableness | Appreciation | Integrity |  |
|  | Low Competitiveness  Readiness to give feedback | Good faith |  |
|  | Search for support |  |  |
|  | Genuineness |  |  |
|  | Altruism |  |  |
|  |  |  |  |
| Conscientiousness | Persistence | Dominance |  |
|  | Task planning | Self-discipline |  |
|  | Goal-orientation | Carefulness |  |
|  | Wish to work | Orderliness |  |
|  | Productivity |  |  |
|  |  |  |  |
| Extraversion | Forcefulness | Readiness to take risks | Sociability |
|  | Energy | Wish for affiliation |  |
|  | Conviviality | Positive attitude |  |
|  |  | Humor  Communicativeness |  |
|  |  |  |  |
| Neuroticism | Equanimity | Confidence |  |
|  | Self attention | Carefreeness |  |
|  |  | Mental balance |  |
|  |  | Drive |  |
|  |  | Emotional robustness |  |
|  |  |  |  |
| Openness to Experience | Creativity | Interest in reading |  |
|  | Wish for variety | Artistic interest |  |
|  | Open-mindedness | Wish to analyze |  |
|  | Willingness to learn |  |  |
|  | Sensitivity |  |  |
|  | Intellect |  |  |

# Discussion

Aim of the current study was to provide an open-access Big Five facet tool and also demonstrate first evidence regarding the scores reliability and validity. The result is a 42 facet measure based on 202 items. The resulting scores are internally consistent and there is evidence regarding their structural as well as test-criterion related validity. Finally, most facets achieved the level of weak factorial invariance rendering them useful for cross-cultural correlational research.

The Big Five solution has been recognized as the most replicable model for personality inventories, reaching a hallmark of consensus in personality science for the last decades. However, some researchers have pointed out that while the Big Five has repeatedely been found when fitting EFA to personality data, its replicability under CFA procedures has been more elusive (R. R. McCrae, Zonderman, Costa, Bond, & Paunonen, 1996). The constriction of the common independent cluster solution, where cross-loadings are restricted to zero, may suppose a rather strong assumption for personality trait inventories (Marsh et al., 2010). The idea of facets, or habits, being influenced by more than one dimension can definitely make some sense. ESEM helps overcoming this assumption and provides a measure about how well the Big Five solution adjusts to the data. Using this procedure, the degree of integration of our proposed set of facets to the Big Five factor solution has been solid enough according to the cut-off values proposed by Marsh et al. (2010). The number of significant cross-loadings in the ESEM models has not been large either, advocating a good discriminant validity.

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

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

We have tested different hypothesis which aim 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 with its peers, finding even bigger associations with some outcomes. As stated in the introduction, Schimmack et al. (2004) could explain 30% of the variability of SWL with a set of NEO-PI-R facets. We reached 38% with our instrument. Evidence regarding academic achievement was similarly attained. While a 10% increase has been reported in the literature in favor of a facet-level set of predictors, we have found a 12% increase in with our instrument. Absences from class could also be predicted with the facet structure of our instrument, explaining about 13% of the variability of the outcome and providing a novel set of facets which could be key in understanding this behavioral outcome. All in all, the benefits from using a broad facet measure of personality have been shown within the criterion ability section.

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

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

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

## 1.4. The Big Five and Personality Disorders

Definitions of personality disorders are steadily shifting from a categorical to a continua conceptualization. This process is not new for personality science history, as personality definitions also underwent a shift from the view of qualitatively distinct categories, called types, to a subset of continuous dimensions, 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 (Section III), which conceptualizes personality disorders as extreme tendencies located in the continuum of the Big Five dimensions and facets (American Psychiatric Association, 2013; Widiger & Mullins-Sweatt, 2009)

This paradigm shift in clinical assessment of personality has led to the construction of the Personality Disorder Inventory (PID-5; 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 dimensions, 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 dimensons predicting PD in a study by Reynolds and Clark (2001). Furthermore, the use of facets may be of extreme utility for those PDs 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 PDs which are not well covered by Big Five dimensions. 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 in current facet models. 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.

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**Appendix**

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| --- | --- | --- |
| Domain | Facet | Item |
| Agreeableness | A1: Appreciation | I acknowledge others’ accomplishments. I respect others’ feelings. I respect others. I am a good listener. I am polite to strangers. |
|  | A2: Integrity | I speak ill of others. (-) I insult people. (-) I do things out of revenge. (-) I misuse power. (-) I try to avoid doing favors for others. (-) |
|  | A3: Low competitiveness | I would like to have more power than other people. (-) I want to control the conversation. (-) I tend to brag about my accomplishments. (-) I want to be told I am right. (-) I see other people as my competitors. (-) |
|  | A4: Readiness to give feedback | I want to be liked. I do what others want me to do. I change myself to suit others. I am afraid of providing criticism. I find it necessary to please the people who have power. |
|  | A5: Search for support | I show my sadness. I show my fear. I show my anger. I tend to complain. I seek support. |
|  | A6: Good faith | I trust what people say. I trust others. I believe that others have good intentions. I am good at working with a group. I feel like a loser if I compromise. (-) |
|  | A7: Genuineness | I lie to get myself out of trouble. (-) I respect authority. I try to fool others. (-) I find it easy to manipulate others. (-) I use flattery to get ahead. (-) |
|  | A8: Altruism | I think of others first. I let other people take the credit for my work. I try to respond with understanding when someone treats me badly. I return extra change when a cashier makes a mistake. |
| Conscientiousness | C1: Dominance | I want to be in charge. I try to lead others. I demand perfection in others. I resist authority. I try to outdo others. |
|  | C2: Persistence | I give up easily. (-) I never give up. I am easily discouraged. (-) I like to take my time. (-) My interests change quickly. (-) |
|  | C3: Self-discipline | I am easily talked into doing silly things. (-) I rush into things. (-) I act impulsively when something is bothering me. (-) I am easily distracted. (-) I say inappropriate things. (-) |
|  | C4: Task planning | I do things according to a plan. I follow a schedule. I make plans and stick to them. I want things to proceed according to plan. I am always prepared. |
|  | C5: Goal orientation | I accomplish a lot of work. I work hard. I put little time and effort into my work. (-) I am a goal-oriented person. I carry out my plans. |
|  | C6: Carefulness | I choose my words with care. I look at the facts. I make careful choices. I avoid mistakes. I take precautions. |
|  | C7: Orderliness | I leave a mess in my room. (-) I often forget to put things back in their proper place. (-) I am continually losing things. (-) I can never find anything. (-) I make a mess of things. (-) |
|  | C8: Wish to work to capacity | I work too much. I have extra time on my hands. (-) I am always busy. I have too many things to do. I am exacting in my work. |
|  | C9: Productivity | I can manage many things at the same time. I start tasks right away. I can`t wait to get started on a project. I finish tasks quickly. I stop when work becomes too difficult. |
| Extraversion | E1: Sociability | I am quiet around strangers. (-) I start conversations. I feel comfortable only with friends. (-) I feel comfortable around people. I have difficulty showing affection. (-) |
|  | E2: Readiness to take risks | I seek danger. I enjoy being reckless. I avoid dangerous situations. (-) I act wild and crazy. I like loud music. |
|  | E3: Wish for affiliation | I prefer to be alone. (-) I enjoy spending time by myself. (-) I enjoy silence. (-) I feel isolated from other people. (-) I hold back my opinions. (-) |
|  | E4: Positive attitude | I look forward to each new day. I look at the bright side of life. I love life. I laugh a lot. I feel lucky most of the time. |
|  | E5: Forcefulness | I automatically take charge. I do most of the talking. I know how to convince others. I like having authority over others. I challenge others’ points of view. |
|  | E6: Communicativeness | I talk a lot. I like talking about myself. I easily share my feelings with others. I love to chat. I disclose my intimate thoughts. |
|  | E7: Humor | I am known for my sense of humor. I try to add some humor to whatever I do. I like to amuse others. I try to tease my friends out of their gloomy moods. I amuse myself easily. |
|  | E8: Conviviality | I enjoy being part of a group. I enjoy teamwork. I am good at planning group activities. I would enjoy a lot of social interaction. I am good at getting people to like me. |
|  | E9: Energy | I maintain high energy throughout the day. I tire out quickly. (-) I am usually active and full of energy. |
| Neuroticism | N1: Equanimity | I get angry easily. (-) I snap at people. (-) I get annoyed at the slightest provocation. (-) I shout or scream when I'm angry. (-) I get upset if others change the way that I have arranged things. (-) |
|  | N2: Confidence | I feel sad. (-) I think my life is a failure. (-) I have a dark outlook on the future. (-) I feel lonely. (-) I feel desperate. (-) |
|  | N3: Carefreeness | I worry a lot. (-) I often feel tense. (-) I am filled with doubts about things. (-) I worry about what people think of me. (-) I feel fearful. (-) |
|  | N4: Mental balance | I remain calm under pressure. I can handle stress well. I face danger confidently. I readily overcome setbacks. I adapt easily to new situations. |
|  | N5: Drive | I feel it hard to get going. (-) I hardly know where my life is going. (-) I give up easily. (-) I let others discourage me. (-) I never spend more than I can afford. (-) |
|  | N6: Emotional robustness | I cry easily. (-) I get overwhelmed by emotions. (-) I need protection. (-) I am easily hurt. (-) I immediately feel sad when hearing of an unhappy event. (-) |
|  | N7: Self-attention | I need the approval of others. (-) I am preoccupied with myself. (-) I feel threatened easily. (-) |
| Openness to experience | O1: Creativity | I do unexpected things. I know that my ideas sometimes surprise people. I pride myself on being original. I ask questions that nobody else does. I love to think up new ways of doing things. |
|  | O2: Wish for variety | I like to visit new places. I like to travel. I am excited by many different activities. I have been creative during the last year. I like concerts. |
|  | O3: Open-mindedness | I am valued by my friends for my good judgment. I am valued by others for my objectivity. I know how to apply my knowledge. I can see different points of view. I come up with alternatives. |
|  | O4: Interest in reading | I read a lot. I like to read. I enjoy discussing books with others. I have read the great literary classics. I enjoy reading nonfiction. |
|  | O5: Artistic interests | I appreciate all forms of art. I like art. I like poetry. I seldom notice the emotional aspects of paintings and pictures. (-) I like to visit museums. |
|  | O6: Wish to analyze | I tend to analyze things. I like to speculate about things. I seek explanations of things. I love to reflect on things. I try to understand myself. |
|  | O7: Willingness to learn | I want to increase my knowledge. I look forward to the opportunity to learn and grow. I find the world a very interesting place. I dislike learning. (-) I am thrilled when I learn something new. |
|  | O8: Sensitivity | I am open about my feelings. I rarely notice my emotional reactions. (-) I find it hard to understand why people get emotional. (-) I am open about myself to others. |
|  | O9: Intellect | I learn quickly. I am quick to understand things. I can handle a lot of information. |

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