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Abstract

The factor structure of the Values in Action Inventory of Strengths (VIA-IS) (Peterson & Seligman, 2004) has not been well established as a result of methodological challenges primarily due to a global positivity factor, item cross-loading across character strengths, and questions concerning the unidimensionality of the scales assessing character strengths. We sought to overcome these methodological challenges by applying exploratory structural equation modeling (ESEM) at the item-level using a bifactor analytic approach to a large sample of 447,573 participants who completed the VIA-IS with all 240 character strengths items and a reduced set of 107 unidimensional character strength items. It was found that a six-factor bifactor structure generally held for the reduced set of unidimensional character strength items; these dimensions were justice, temperance, courage, wisdom, transcendence, humanity, and an overarching general factor that is best described as dispositional positivity.

Keywords: factor structure; bifactor model; exploratory structural equation modeling (ESEM); virtues; VIA-IS

What is the public significance of this article?

The present study suggests that the lack of consistency across studies in the number and nature of broad dimensions of character assessed using the Values in Action Inventory of Strengths (VIA-IS) has been a result of subscale items measuring indistinct character traits. After addressing this issue, the VIA-IS appears to be assessing character dimensions of justice, temperance, courage, wisdom, transcendence, humanity, and an overarching dispositional positivity dimension.

The factor structure of the Values in Action Inventory of Strengths (VIA-IS): An item-level

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The advent of positive psychology has refocused attention on the scholarly research of positive

individual differences (Seligman & Csikszentmihalyi, 2000). The growing body of literature in

this area has demonstrated positive psychological characteristics' ability to predict various forms

of well-being (e.g., Park, Peterson, & Seligman, 2004) as well as performance (Harzer & Ruch,

2014;Park & Peterson, 2006). Furthermore, positive psychological traits have been shown to be

amenable to change (Seligman, Steen, Park, & Peterson, 2005). As such, establishing an

empirical classification scheme of positive psychological traits can enable their accurate

diagnosis, which is vital for optimal functioning and flourishing (Peterson, 2006).

However, attempts to recover a consistent classification scheme have not been without

challenges. Dahlsgaard, Peterson, and Seligman (2005) found through textual analysis that there

were six ubiquitously valued virtues: courage, justice, temperance, wisdom, humanity, and

transcendence. Peterson and Seligman (2004) took a top-down, theoretical approach by positing

24 strengths of character that represented the psychological mechanisms individuals could

cultivate as expressions of the six virtues (for more information see online supplemental

materials, Table S1). This resulted in the development of the primary contemporary character

strength assessment tool known as the VIA-IS (Peterson & Seligman, 2004). Peterson and

Seligman (2004) found that a five-factor structure emerged empirically from analyzing the 24

character strengths, which has tended to be the most common factor structure despite a range of

solutions (see for review McGrath, 2014; Niemic, 2013) across studies; in no case did a six-

factor solution emerge. Some researchers who have investigated the factor structure of the VIA-

IS have interpreted this as a misalignment between a theoretically proposed and empirical factor

structure (Brdar & Kashdan, 2010; Duan et al., 2012; Khumalo, Wissing, & Temane, 2008; Macdonald, Bore, & Munro, 2008; Shryack, Steger, Krueger, & Kallie, 2010), whereas others suggest that the classification of character strengths under the six core virtues never represented a claim about how the latter would empirically emerge from the former, but was rather simply a classification scheme (e.g., McGrath, 2014; Ruch & Proyer, 2015). Nevertheless, purely empirical, bottom-up approaches to analyzing the factor structure of virtues (Cawley, Martin, & Johnson, 2000) suggests conceptual correspondence with Peterson and Seligman's (2004) classification scheme (see online supplemental materials, Table S1). Given the inconsistent factor solutions and uncertainty about whether a six-factor solution was implicated by Peterson and Seligman (2004), we move forward by a) reviewing and addressing psychometric issues with the VIA-IS that may be distorting the underlying factor structure which b) could be a six-factor solution that corresponds to the classification scheme Peterson and Seligman (2004) delineated.

Challenge of Global Factor of Positivity or Social Desirability

One potential reason for the factor structure issues with the VIA-IS is the presence of a global positivity factor, which shares conceptual space with social desirability. Because the VIA-IS was developed to capture morally valued individual differences, Peterson and Seligman (2004) asserted character strengths are by conceptualization socially desirable, which has some empirical evidence (e.g., MacDonald, Bore, & Munro, 2008).

A relevant approach for modeling a general factor is bifactor modeling, which involves extracting a general factor that is orthogonal to subsequently extracted group factors, each of which are orthogonal to each other (Holzinger & Harman, 1938; Holzinger & Swineford, 1937). There are two advantages to using a bifactor model approach over related approaches like second-order modeling (Chen, West, & Sousa, 2006). First, bifactor modeling allows for easier

detection of group factors when group factors are not independent of the general factor. This allows for a more representative group factor structure beyond the general factor. Second, bifactor models do not have arbitrary restrictions specified in higher-order models where the amount of variance accounted for by the general factor in indicators is a multiplication of the indicator loading on the lower-order factor and the loading of the lower-order factor on the higher-order factor. Despite these advantages, no past studies have applied bifactor modeling to ascertain the structure of the VIA-IS.

Challenge of Cross-loadings

Another methodological limitation not addressed in past studies is that the vast majority have not used confirmatory approaches to examine the structure of the VIA-IS. Past methods have primarily emphasized principal components analysis (PCA) and exploratory factor analysis (EFA) (McGrath, 2014). Although both PCA and EFA serve as useful heuristics to confirmatory approaches (Gerbing & Hamilton, 1996), confirmatory approaches are the recognized standard for validating the internal structure of constructs (Clark & Watson, 1995). Despite this recognition, confirmatory factor analysis (CFA) may not be well suited for VIA-IS data. Character strengths share similar methodological challenges with personality trait assessment in construct validation. In assessing the general structure of personality traits, Hopwood and Donnellan (2010) demonstrated that unlike exploratory approaches, CFA does not produce adequate fit. The key reason is that personality statements are imperfect indicators of underlying traits: they are often written and/or interpreted to reflect more than a single trait. This leads to substantial cross-loadings, a consequence that violates the CFA assumption of zero magnitude cross-loadings (i.e., simple structure). Therefore, CFA is too restrictive when evaluating omnibus inventories of personality traits. As such, personality researchers have recommended the

continued use of exploratory methods in assessing the internal structure of personality (e.g.,

Goldberg & Velicer, 2006) despite the traditional recognition that CFA is the best practice for

validating internal structure.

In view of the limitations of CFA, exploratory structural equation modeling (ESEM)

(Marsh et al., 2010) has been proposed as an innovative alternative (Hopwood & Donnellan,

2010). The ESEM approach integrates both EFA and CFA and allows for small cross-loadings of

factor indicators that more realistically represent respondent data (e.g., Marsh et al., 2010; Marsh,

Nagengast, & Morin, 2013). This allowance of small cross-loadings accounts for both imperfect

indicators and social desirability responding. Moreover, with targeted rotations and the

specification of loadings to specific factors using clustered exploratory structural equation

modeling (CESEM), we can specify the proposed model a priori and take a confirmatory

approach to determine whether the categorization of character strengths under six virtues

emerges empirically (Browne, 2001).

Challenge of Unidimensionality

Related to the issue of confirmatory approaches, past studies have generally used

indicators of 24 character strengths in the VIA-IS without confirming that they are

unidimensional. Non-unidimensional facet scales can contain items that tap into more than one

factor, resulting in a less clear factor structure that evidences poor model fit (Hopwood &

Donnellan, 2010). This is may be an additional reason for the lack of consensus regarding the

factor structure of the VIA-IS. Although the VIA-IS character strengths scores have

demonstrated good reliability, internal consistency does not necessarily suggest

unidimensionality (Clark & Watson, 1995;Cortina, 1993). In fact, studies that explored the VIA-

IS at the item-level (e.g., McGrath, 2014) have found the VIA-IS character strength scales

evidenced poor unidimensionality. Therefore, we seek to examine the structure of the VIA-IS using items that form unidimensional character strength scales to derive a clearer structure.

Summary of current study

Our current study used a large sample of participants, which enabled us to explore and confirm the structure of the VIA-IS based on the classification scheme of 24 character strengths under six virtues by addressing the potential general positivity factor that may be obscuring its emergence. We endeavored to overcome limitations found in past studies by (a) using bifactor modeling, (b) applying ESEM models that account for small cross-loadings, and (c) ensuring unidimensional character strengths. Further, to our knowledge, this is the first paper to examine the entire factor structure of the VIA-IS at the item-level. Past papers have used parceling techniques which may be inappropriate (Herbert W. Marsh, Lüdtke, Nagengast, Morin, & Von Davier, 2013), especially in the presence of a lack of unidimensionality. We examined and compared the factor structure of the full VIA-IS scale and a reduced VIA-IS scale that has unidimensional character strengths.

METHOD

In total, 447,577 subjects were surveyed online through the VIA website (www.viacharacter.org) during a three-year period (Year 2010-2013). About 56% of the participants were female. Most participants (75.3%) fell in the "Young Adult" age group (age 18-44), followed by 16.2% of participants in the "Middle Age" group (age 45-64), 6.8% in the "Youth" group (age below 18), and 1.7% in the "Elderly" group (age 65+). Participants were from 231 different countries, with 6.5% from the United States. Other major sources of nations included Australia (11.6%), Canada (4.1%), the United Kingdom (3.8%), and China (1.8%). Participants had to create an account, answer some demographic questions, and then were

allowed access to the English version of this survey. Although respondents' proficiency in English was not tested, it is expected that if a person is able to navigate the website to complete the registration process that they were sufficiently fluent to take the survey. Four people did not answer any of the scale questions (final $N = 447,573$).

The *Values in Action Inventory of Strengths* (VIA-IS) scale (Peterson & Seligman, 2004) was used to provide an integrative measure of character strengths. The VIA-IS consists of 10 items for each of the 24 character strengths for a total of 240 items; their organization under the six virtues is displayed in the online supplemental materials, Table S1. Participants were asked to rate each item based on a 5-point Likert scale, with response options ranging from 1 ("Very Much Unlike Me") to 5 ("Very Much Like Me").

Model fit. Although there are no absolute standards, determining model fit requires consideration of a range of fit indices which may evidence good or close fit (e.g., SRMR < .08, RMSEA < .06, TLI > .95, and CFI > .95; Hu & Bentler, 1999). However, such stringent cutoffs may not be appropriate depending on sample size and model complexity (Marsh, Hau, & Wen, 2004); cutoffs for acceptable levels of fit (e.g., CFI and TLI > .90; Bentler & Bonett, 1980) or reasonable deviation from it (e.g., RMSEA < .8, reject models RMSEA > .10; Browne & Cudeck, 1993) have also been proposed. We assess model fit by rejecting models that do not meet bare minimum cutoffs for any one index and using combinatorial rules (i.e., TLI < .95 and SRMR >.06, CFI < .96 and SRMR > .06, or RMSEA > .06 and SRMR > .09; Hu & Bentler, 1999) for rejection in cases where at least one index did not meet cutoffs for good or close fit.

Preliminary analysis of full scale items. We ran a series of analyses using maximum likelihood parameter estimates with robust standard errors (MLR) to test our hypotheses regarding the lack of unidimensionality of each of the character strengths and the limitations of

using CFA to model Peterson and Seligman's (2004) classification scheme of 24 character

strengths under six virtues within a latent variable model framework. A CFA model specifying

the 240 items loading onto their respective character strengths and alternative models using

CESEM, both with and without a general factor, whereby items for a given character strength are

allowed to cross-load onto other strengths classified into the same overarching virtue were tested

for model fit.

Unidimensionality of character strengths. On the basis of the results from the prior

series of analyses, it was necessary to establish a unidimensional measure for each character

strength. We first split up the whole sample into a calibration subsample consisting of odd-

numbered subjects, and a validation subsample consisting of even-numbered subjects. Then for

each of the character strength, we conducted unidimensional CFA using maximum likelihood

parameter estimation with Satorra-Bentler corrections in the calibration subsample to examine

the unidimensionality of character strength measures. Model fit was assessed in each case by

examining the default fit indices reported by Mplus 7.0 (Muthén & Muthén, 1998-2012). If the

measurement model for the character strength failed to satisfy the acceptable model fit criteria,

the item with the lowest factor loading was deleted and fit re-analyzed. This process proceeded

iteratively until satisfactory fit was achieved. The resulting unidimensional measures of character

strength were then examined in the validation subsample to guarantee generalizability.

Confirmation of general factor structure using item-level data. Past research on the

VIA-IS using taxometric analyses has shown that a latent dimensional model demonstrates better

fit to the data than a latent categorical model (McGrath, Rashid, Park, & Peterson, 2010). Thus,

we first sought to confirm the proposed hierarchical model using CFA (MLR estimator), both

with and without an overarching third-order explaining covariation of the six, second-order

virtue factors. We then analyzed the data using CESEM (MLR estimator), models with items rotated to load onto their respective character strengths and allowed to cross-load onto character strengths categorized under the same virtue, both with and without a general factor.

RESULTS AND DISCUSSION

More detailed results are available in supplemental tables in the online supplemental materials. The CFA model using all 240 items loading onto the 24 character strengths demonstrated very poor fit (CFI = .69, TLI = .69, RMSEA = .04, and SRMR = .06). That the CESEM (CFI = .78, TLI = .77, RMSEA = .03, and SRMR = .04) and CESEM-bifactor (CFI = .80, TLI = .79, RMSEA = .03, and SRMR = .07) models showed progressively better fit relative to the CFA model indicates that CFA's assumption of zero cross-loadings is overly restrictive and that a bifactor model may be more reflective of the pattern of covariation of item-level scores, respectively. Nevertheless, the overall fit even with the CESEM-bifactor model was still poor, suggesting that the issue of unidimensionality of character scales needs to be addressed.

The model fit results indicate all character strengths demonstrate satisfactory unidimensional fit only after item reductions to 4 or 5 indicators, with all CFI and TLI values over .90 (CFI range = .96 – 1.00, M = .98; TLI range = .91 – 1.00, M = .96), SRMR values below .08 (range = 0 – .03, M = .02), and all RMSEA values under .10 (range = .02 – .10 [rounded up from .095], M = .07). All models where the RMSEA exceeded .08 passed all the combinatorial cutoff rules. Further, character strength scores demonstrated acceptable to good reliabilities, ranging from omega = .69 to .90 (M = .78) with the exception of self-regulation, which had a slightly lower omega of .63. Using this reduced set of indicators, we then examined the model fit indices in the validation sample for each character strength. Similar satisfactory

model fit results were obtained. For more detailed information, see online supplemental materials, Table S2.

A 24-factor solution using CFA on the 107 items did not show adequate fit (CFI = .85, TLI = .84, RMSEA = .03, and SRMR = .05), nor did a hierarchical model with 24 first-order factors, six second-order factors representing the virtues, and a third-order factor representing an overarching "character" factor (CFI = .79, TLI = .79, RMSEA = .04, and SRMR = .07). Model results using CESEM showed that a 24-factor model was on the verge of attaining acceptable fit (CFI = .90, TLI = .89, RMSEA = .03, and SRMR = .03). Finally, adding a general factor to explain items' covariation via a CESEM bifactor model improved fit indices to acceptable levels (CFI = .92, TLI = .90, RMSEA = .03, and SRMR = .03), passed combinatorial cutoff rules, and fit significantly better than the CESEM model, $\Delta\chi^2 (107) = 302265$, $p < .001$.

The targeted CESEM rotation produced loading patterns that were generally expected of the model after extracting the general factor. In general, the strongest loading items for each of the 24 character strengths were those intended to measure their respective character strengths. There were several exceptions where the items placed within one to two positions away from being in the group of highest-loading items for their respective character strengths. One item intended to measure hope loaded the lowest of all items allowed to load onto hope and one item intended to measure zest was the third lowest loading of all items allowed to load onto zest. These anomalies were likely due to modeling the general factor, which was largely defined by items that were intended to tap these two strengths.

One primary issue when taking a bifactor modeling approach is interpretation of the general factor that is common to all indicators (Reise, Moore, & Haviland, 2010). In the present study, the two main hypothesized conceptualizations (not mutually exclusive) of this general

factor is either a method factor that reflects social desirability or positivity. Inspection of the

items' factor loadings (for full information see online supplemental materials, Table S3) on this

general factor would suggest more of the latter for three reasons. First, all zest, hope, and four of

five curiosity items loaded strongly (i.e., $\geq .45$) on this general factor, even more so than their

respective group factors, onto which the items generally loaded at low levels. These three

strengths have been shown to be the most robust, cross-culturally invariant predictors of various

measures of well-being (e.g., happiness, life satisfaction, see Niemiec, 2013) and most of the

strengths that loaded most weakly on the general factor (i.e., $\leq .30$) such as all prudence and

modesty items tend to be the least associated with life satisfaction (Park et al., 2004). The pattern

of loadings suggests the common factor captures a sort of dispositional positivity. This

corroborates with prior factor analytic research on character strengths that has found a factor

largely defined by zest and hope best described as vitality or positivity (Brdar & Kashdan, 2010;

Macdonald et al., 2008) as well as research on subjective well-being research that has

demonstrated its largely dispositional nature, sharing substantial overlap with stable traits (e.g.,

Steel, Schmidt, & Shultz, 2008). Second, despite prudence generally having the strongest

association with various measures of social desirability of any character strength (Peterson &

Park, 2004; Ruch et al., 2010), the items that loaded the lowest on the general factor in the

present study were prudence and modesty items (i.e., $\leq .23$), just as MacDonald and colleagues

(2008) found in their investigation of a one factor solution on which neither of these two

strengths loaded. This would seem to indicate that the general factor is likely not simply tapping

into social desirability. Third, there does not seem to be any systematic relationship between

whether character strength items loaded strongly (hope and zest) or weakly (prudence and

modesty) onto the general factor and the overall level of virtuousness that has been ascribed to

each character strength (hope [3.26], zest [2.72], prudence [3.10], modesty [3.36]; Ruch &

Proyer, 2015). In sum, the general factor appears to capture substantive dispositional tendencies

towards well-being rather than a methodological artifact. It is nevertheless possible that this

general factor represents a prevalence of positivity-related words or perceived positivity of the

items themselves.

In general, the results suggest that the character strengths data conforms to the character

strengths classification proposed by Peterson and Seligman (2004) when the general positivity

factor, cross-loadings of indicators across character strengths, and a lack of unidimensionality of

the scales assessing character strengths are addressed. At the same time, this analysis reveals that

the 240 items used to assess character strengths may not be as good a representation of the

character strengths classification compared to the reduced set of 107 items. Correlations between

corresponding character strengths scales using the full set of items and the reduced set of items

were very high (rs range from .88 to .95) and there were hardly any effect size differences

(Cohen's ds range from -.23 to .25 except for honesty [-.55] and love of learning [-.46]. A

substantive implication for researchers and practitioners is to use this reduced set of character

strengths items instead of the full set (see online supplemental materials, Table S3, for reduced

item set and item labels).

The results do need to be interpreted with some amount of caution since over half of the

items were deleted to achieve unidimensionality of character strengths. While there may be a

concern about reduction in content validity, this is arguably justified in this particular case where

we are specifically investigating the factor structure of a measure that has demonstrated varying

solutions across studies and have reason to believe that this is a result of lack of

unidimensionality contributing to increased frequency and magnitude of cross-loadings. The

series of preliminary analyses on the full 240 items using CFA to model 24 factors indicated that

item removal was essentially required; even clustered ESEM models, allowing items to cross-

load onto character strengths categorized under the same virtue, still did not show adequate fit

for a 24-factor model. This demonstrates the importance of doing initial factorial validation work

in scale creation.

We must consider whether the group factors explain substantial score variability beyond the

common factor (Reise et al., 2010). Of the 107 items, 30 items loaded more strongly onto the

general factor than their intended character strength specific factor, suggesting the general factor

is substantive. Eighteen items loaded ≤ .30 on their intended character strength and in all but one

case these items loaded more strongly onto the general factor (range = .31 to .75, median = .56).

Nevertheless, items generally tended to load more strongly onto their intended character strength

(range = -.14 to .80, median = .53) than the general factor (range = .01 to .75, median = .37).

Furthermore, the character strength items largely defining the general factor (i.e., zest, hope,

curiosity) cut across a few of the six overarching virtues (i.e., courage, transcendence, and

wisdom, respectively) as did those loading the lowest on the general factor (i.e., items for

prudence and modesty [temperance], most judgment items [wisdom], and most fairness items

[justice]). Thus, even with a strong general factor, the substantive group factors that emerged

from the first ever confirmatory item-level factor structure analyses of the VIA-IS indicate some

empirical support for Peterson and Seligman's (2004) classification scheme, but this may require

a reduced item set.

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