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The Chernyshenko Conscientiousness Scales: A New Facet Measure of Conscientiousness

Jessica A. Green¹, Daryl B. O'Connor¹, Nicola Gartland¹ and Brent W. Roberts²

In press

Assessment

School of Psychology¹

University of Leeds

Department of Psychology²

University of Illinois

Corresponding author

Daryl B. O'Connor

School of Psychology

University of Leeds, UK

Email: d.b.oconnor@leeds.ac.uk

Tel: ++113 343 5727

Fax: ++113 343 5749

ABSTRACT

The current research sought to validate the Chernyshenko Conscientiousness Scales (CCS), a novel measure designed to assess six facets of conscientiousness. Data from 7569 US and 649 UK participants were analysed to assess the internal reliability and factorial structure of the scales. Test-retest reliability, convergent and divergent validity, and criterion-related validity were also evaluated using a separate UK sample (n=118; n=80 for test-retest). The results showed that those items designed to measure industriousness, order, self-control, traditionalism and virtue were best represented by a five-factor structure, broadly consistent with the five scales. However, the content and structure of the responsibility scale requires further investigation. Overall, the CCS has the potential to be a useful alternative to the faceted measures of conscientiousness that are currently available. However, future research is required to refine a number of problematic items and to clarify which facets can be better described as interstitial dimensions between conscientiousness and other big five domains.

Keywords: Personality, Big Five, International Personality Item Pool, Traits, Reliability, Validity

INTRODUCTION

Conscientiousness, along with Extraversion, Agreeableness, Neuroticism and Openness to experience, is one of five broad personality domains outlined in the Five-Factor Model of Personality (McCrae & John, 1992). Highly conscientious individuals are more likely to adhere to socially prescribed norms and rules, have the propensity to be goal-directed and organised, and delay gratification and control one's impulses (John & Srivastava, 1999). Research has demonstrated how individual differences in conscientiousness can predict a range of important outcomes including occupational performance (Dudley, Orvis, Lebiecki, & Cortina, 2006; Judge, Higgins, Thoresen, & Barrick, 1999), marital stability (Roberts & Bogg, 2004; Tucker, Kressin, Spiro, & Ruscio, 1998), stress appraisals (Gartland, O'Connor & Lawton, 2012; health-related behaviours (Bogg & Roberts, 2004; Hagger-Johnson, Berwick, Conner, O'Connor & Shickle, 2012; O'Connor, Conner, Jones, McMillan & Ferguson, 2009; Walton & Roberts, 2004), physical and mental wellbeing (Goodwin & Friedman, 2006; Kendler & Myers, 2010), and longevity (Kern & Friedman, 2008). In addition, it is comparable to well-established determinants such as socioeconomic status and education attainment in predicting health and mortality (Roberts, Kuncel, Shiner, Caspi, & Goldberg, 2007).

However, conscientiousness is not a unitary construct, but rather a broad domain best conceptualized as a family of related, but distinct stable tendencies and characteristics (Roberts, Jackson, Fayard, Edmonds, & Meints, 2009). Many validated personality inventories are available that measure conscientiousness at the facet level, for example; the revised NEO Personality Inventory (NEO-PI-R; Costa & McCrae, 1992), the HEXACO Personality Inventory Revised (HEXACO-PI-R; Lee & Ashton, 2004), and the Abridged Big Five Dimensional Circumplex Model (AB5C; Hofstee, de Raad, & Goldberg, 1992). These measures are based on different models of personality that vary in how they define

conscientiousness and its lower-order traits, resulting in some disagreement about what traits are at the core of conscientiousness. Our understanding of how conscientiousness may influence important behavioural and health outcomes is only as good as our understanding of the construct itself (Roberts, Lejuez, Krueger, Richards, & Hill, 2014). Therefore basic research that clarifies the lower-order facets of conscientiousness is necessary if we are to advance and push forward our knowledge of this important personality domain.

A number of studies have sought to identify the underlying structure of conscientiousness, largely through lexical examination of trait adjectives (Peabody & De Raad, 2002; Perugini & Gallucci, 1997; Roberts, Bogg, Walton, Chernyshenko, & Stark, 2004; Saucier & Ostendorf, 1999). However, most of these studies were based on a circumplex model of personality (e.g. the AB5C), with none of the proposed solutions being in agreement with one another or providing a comprehensive account of all the identified facets. Driven by this lack of an all-inclusive taxonomy of conscientiousness facets, Roberts, Chernyshenko, Stark and Goldberg (2005) aimed to empirically derive a common shared structure of conscientiousness by factor analysing scores from thirty-six scales conceptually related to conscientiousness. These scales were taken from seven widely used personality inventories developed under different theoretical considerations, increasing the likelihood that the key conscientiousness-related facets would have been captured to some degree. A six factor solution comprising of industriousness, order, self-control, responsibility, traditionalism and virtue was found to best represent the data. These facets converged to form a single higher-order domain of conscientiousness, yet tests of criterion-related validity revealed the six traits to differentially relate to relevant outcomes (drug use, work dedication, preventive health behaviours, traffic risk), demonstrating why it is necessary to examine specific facets rather than a global domain.

Roberts et al. (2005) concluded their six-factor solution to be more comprehensive than previous conceptualisations, as none of the scales included in their analyses were found to capture more than three of the six identified facets. For example, factor analyses showed four of the six NEO-PI-R conscientiousness facets to load onto industriousness, with the other two facets (order and deliberation) only demonstrating salient loadings onto order and self-control components. Therefore, a comprehensive scale that captures the entire breadth of the domain is required to further aid investigation into the relationship between conscientiousness and important criterion variables.

The Chernyshenko Conscientiousness Scales (CCS; Chernyshenko, 2002; Hill & Roberts, 2012) was developed for this purpose. Developed as part of a doctoral dissertation (Chernyshenko, 2002), this 60-item inventory consists of six fairly heterogeneous scales. This allows measurement of the different ways that one can be conscientiousness, with individuals being able to score high on some facets yet low on others. The six facets have demonstrated reliabilities of at least $\alpha = .87$ (Hill & Roberts, 2012), and good criterion-related validity, predicting outcomes such as student study, work and health behaviours (e.g. Gartland, O'Connor, Lawton, & Ferguson, 2014). Validation of the order scale was reported by Chernyshenko, Stark, Drasgow and Roberts (2007), however the psychometric properties of the other five scales have not been published. Until the scale is fully validated, researchers wanting to assess conscientiousness will be limited to subscales from personality inventories that may not assess the entire breadth of the domain. In addition, to the best of our knowledge, the scale has only been used in US populations; therefore, we were also interested in exploring its reliability and validity in a UK-based sample.

To summarise, the objective of the current research was to examine the reliability and validity of the Chernyshenko Conscientiousness Scales. In order to meet this objective two studies were conducted. In Study 1, we aimed to assess the internal reliability of the six facet

scales and examine whether the 60 items loaded onto a factor structure reflecting the proposed six facets. In order to examine whether the scale was appropriate for use outside of the US, and to examine consistency across populations, the above analyses were carried out using a large US sample and then replicated using a UK sample. In Study 2, we aimed to further investigate the psychometric properties of the CCS by exploring test-retest reliability, convergent and divergent validity, and criterion-related validity in an additional, smaller sample of UK-based participants.

STUDY 1

METHOD

Participants

US sample. The participants who completed the CCS were not actively recruited; they were individuals who visited websites related to R Chris Fraley's and Brent W. Roberts' assessment-related web sites (<http://www.psychology.illinois.edu/people/bwrobrts>). Links on these websites indicated that individuals could answer for themselves "How Conscientious are You?" by completing the survey. Once the CCS was put up on the web, it passively collected responses from interested participants.

In total, data were available for 9285 participants who had started to complete the CCS online. Participants were asked to indicate whether they had previously completed the questionnaire, and those who reported yes were excluded from the analysis ($n=827$). Participants who reported being less than 16 years of age or over 80 years of age were also excluded. Therefore 7900 eligible participants made up the US sample. However, after listwise deletion this was reduced to 7569 participants; 5289 females (69.9%), 2245 males (29.7%) and 35 who did not report their gender (0.5%). Participants were aged 16 to 77 years, with a mean age of 29.83 ± 12.41 years.

UK sample. This dataset was collated from four studies carried out in the UK that administered the CCS as part of their design. All studies recruited participants using an opportunity sampling method, in which participants responded to public advertisements and volunteered to take part. Data were available for 696 participants, with the respective sample sizes of the four studies being 100, 103, 231, and 262. However, 47 participants were excluded from the current analysis due to insufficient data for the CCS. Therefore, the final UK population sample included 649 participants; 486 females (74.9%), 159 males (24.5%), and 4 participants who did not report their gender (0.6%). Participants were aged 18 to 78 years, with a mean age of 26.53 ± 10.65 years.

Design and Measures

For each sample, conscientiousness was assessed cross-sectionally using the Chernyshenko Conscientiousness Scales (Chernyshenko, 2002; Hill & Roberts, 2012); a 60-item questionnaire made up of six scales, each designed to measure one of the six facets of conscientiousness described by Roberts et al. (2005). The full scale can be found online in Appendix 1. Industriousness reflects the degree one is ambitious and hardworking (example item: 'I try to be the best at anything I do'). Order refers to the tendency to plan ahead, be organised and neat (example item: 'organisation is a key component of everything I do'). Self-control is the propensity to be cautious and able to delay gratification, rather than being impulsive and careless (example item: 'I rarely jump into something without first thinking about it'). Responsibility is concerned with being dependable, cooperative and a service to others (example item: 'I go out of my way to keep my promises'). Virtue reflects being honest, moral and a Good Samaritan (example item: 'The people who know me best would say that I am honest'), and traditionalism reflects adherence to societal rules and norms, and the tendency to respect authority (example item: 'I support long-established rules and traditions'). Each facet scale consists of 10 items. The US studies scored items on 4-point

Likert scale, ranging from 1 (disagree strongly) to 4 (agree strongly), whereas the UK participants rated items on a 5-point scale ranging from 1 (very inaccurate) to 5 (very accurate). High scores on any scale indicated that an individual was high in that lower-order facet; however there was no cut-off score to distinguish people as high or low in conscientiousness (Hill & Roberts, 2012).

Statistical Analysis

The internal reliability of each facet scale was first assessed by examining Cronbach's Alpha values. Item-total statistics were also examined to identify problematic items with corrected item-total correlations of less than .3, as these may decrease scale reliability (Field, 2009, p. 678).

Before carrying out factor analysis two methods were employed to statistically determine the optimal number of factors underlying the data; parallel analysis (PA; Horn, 1965) and the minimum average partial (MAP) test (Velicer, 1976). Both tests are well-regarded and using multiple techniques has the added advantage of being able to seek convergence of results (Hayton, Allen, & Scarpello, 2004; Zwick & Velicer, 1986). PA and the MAP test complement each other well; the MAP test rejects factors that have few item loadings, which can lead to under extraction, whereas PA has demonstrated a tendency to over extract the optimal number of components (Ledesma & Valero-Mora, 2007; O'Connor, 2000). Therefore, comparing the two solutions can assist in making the most accurate decision regarding factor retention.

Guided by the factor retention solutions, data were factor analysed with principal axis factoring (PAF) selected as the extraction method. PAF was performed with an oblique (direct oblimin) rotation; the preferred method when factors are hypothesised to be related (Field, 2009, p. 664). Although the facet scales should measure different dimensions of conscientiousness, they have previously been found to converge into one single higher-order

domain of Conscientiousness (Roberts et al., 2005), and therefore an oblique rotation was more appropriate than an orthogonal rotation for this dataset.

RESULTS

Descriptive Statistics

CCS scores, for both the US and UK participants, are presented in Table 1. Although it appears that the US participants scored lower on all facets, this is due to the different Likert scales adopted across the two populations. In both datasets, participants scored highest on industriousness and responsibility, and lowest on traditionalism. Additionally, all facet scales were significantly correlated, and most of these correlations were moderate in magnitude. This suggests that despite the lower order facets being related, they were measuring different aspects of conscientiousness. However, in both samples a large effect size was found between responsibility and industriousness, indicating there may be greater overlap between these scales than the remaining facets.

Scale Reliability

Table 1 also displays the Cronbach's Alpha values for each facet scale, with the US and UK data analysed individually. For the US sample, all facet scales demonstrated good internal reliability ($\alpha \geq 0.80$); with the exception of the responsibility scale which was acceptable ($\alpha \geq 0.70$). This was replicated in the UK sample; with order, self-control, and industriousness showing good internal reliability ($\alpha \geq 0.80$), and the internal reliability of the responsibility scale again being acceptable ($\alpha \geq 0.70$). Cronbach's Alpha values for traditionalism and virtue were lower in the UK sample, but still within the acceptable range (in accordance with Cortina, 1993).

In both sets of data, two items demonstrated corrected item-total correlations of less than .3; "*I dislike people around impulsive people*" [SC9], and "*I would gladly spend some of my leisure time trying to improve my community*" [RESP5]. Furthermore, removal of item

9 from the self-control scale was found to improve the scale's alpha value across both datasets. Three additional items were found to perform poorly in the UK data; "*In my opinion, censorship slows down the progress*" [TRAD9], "*I am not the most responsible group member, but I will not shirk on my duties either*" [RESP7], and "*I have a reputation for being late for almost every meeting or event*" [RESP10].

Factor Retention Analyses

Table 2 presents the results of parallel analysis and the MAP test. As expected the MAP test recommended smaller factor solutions compared to parallel analysis. Excluding those items that were identified as problematic from the UK analyses resulted in agreement between the two tests, increasing our confidence that five is the optimal number of factors to retain. However, removal of the two items that performed poorly within the US data did not improve convergence. US analyses were repeated after also removing those items identified as problematic in the UK sample, as they also demonstrated low ($<.4$) corrected item-total correlations in the US sample. However the factor retention analyses remained incongruent, signifying that multiple analyses should be run in order to determine the cleanest factor structure for the US data.

Factor Analysis

US sample. Due to the inconclusive findings of the factor retention tests, multiple PAF analyses were conducted with an oblique rotation (direct Oblimin), extracting six to nine factors. Item loading tables were then analysed for meaningful factors, defined as having more than three items loading at above .30, and no or few cross-loading items (Costello & Osborne, 2005). These four solutions all included trivial factors; therefore a five-factor solution was also extracted.

This five-factor solution was the most coherent for the data, with all five factors having four to five strongly loading items ($<.5$) and only one cross-loading item

(Supplementary Table 1). Those items intended to measure order, virtue, self-control and industriousness loaded together as expected on individual components, largely reflecting the facet scales. Only Item SC9, which was identified as problematic in the reliability analysis, loaded at less than .3 on the appropriate component. Nine of the 10 traditionalism items also held up as a singular factor, with item TRAD7 ('When I was in school, I used to break rules quite regularly') demonstrating the strongest loading onto the component best representing self-control (0.35). However, item TRAD3 ('Even if I knew how to get around the rules without breaking them, I would not do it') cross-loaded with the virtue items, which may suggest that this item measures a blend of traditionalism and virtue.

In comparison, the responsibility scale was highly problematic and did not hold up when subjected to factor analysis. In the five-factor solution three of the items (RESP1-RESP3) clustered with the industriousness items, and items RESP4 and RESP9 loaded onto the component best representing virtue. A six-factor extraction resulted in only minor changes with item RESP4 ('I go out of my way to keep my promises') being the sole item to show a salient loading onto a sixth factor. Factor solutions with 8 and 9 components did result in up to five responsibility items clustering together on an individual component, however no item demonstrated a strong loading ($<.5$) and increasing the number of factors to retain produced multiple meaningless components.

UK sample. A five-factor extraction with an oblique rotation (direct Oblimin) was repeated on the UK data (Supplementary Table 2), and the pattern of factor loadings largely replicated the US analysis. Those items designed to measure industriousness, order and self-control generally clustered as expected across three components. Again item SC9 ('I dislike being around impulsive people') did not show any salient loading, instead weakly cross-loading across self-control and traditionalism. This confirms the item measures a blend of the two facets and may need to be removed from the scale. However, item IND9 ('Setting goals

and achieving them is not very important to me'), did not demonstrate an important loading on the industriousness component, indicating that this item does not perform as well when administered to a UK population.

Akin to the US data, the traditionalism items measuring rule-abiding (TRAD3 and TRAD7) were also problematic here, confirming they are complex items not solely capturing traditionalism. Again, item TRAD3 loaded the strongest on the component representing virtue, and item TRAD7 did not show a salient loading on any component, only weak equivalent loadings on traditionalism and self-control. In contrast to the US results, item TRAD9 ('in my opinion, censorship slows down the progress') only loaded at .21 here; supporting the finding of the reliability analysis that this item may be unsuitable for use within a UK audience.

Most of the virtue items also loaded onto a distinct component, however not as strongly or consistently as when analysed in the previous sample, with VIRT6 and VIRT7 having factor loadings $<.3$. Examining how these items loaded onto other components revealed that item VIRT6 ('I would rather get a bad grade than copy someone else's homework and turn it in as my own') may also be tapping into industriousness, and item VIRT7 ('It bothers me when other people cheat on their taxes') may measure a blend of industriousness, traditionalism and virtue.

A similar pattern regarding the responsibility items also emerged in the UK data. In a five-factor solution the same items loaded onto the components representing industrious (RESP1-RESP3) and virtue (RES9). Increasing the number of factors to retain did not reveal a more meaningful factor solution, with a six-factor extraction resulting in no salient loadings on a sixth factor. Therefore, it can be concluded that the responsibility items consistently do not emerge as a coherent factor.

To examine the similarity of the US and UK five-factor solutions, Tucker's congruence coefficient (Tucker, 1951) was computed for each comparable factor pair. In the 60-item analyses the component pairs demonstrated congruence levels ranging from -.95 (virtue) to .99 (order). This indicates the factor solutions from the two populations display good similarity based on the critical congruence levels established by Lorenzo-Seva and ten Berge (2006). Re-analysis after removal of the responsibility scale revealed similar levels of equivalence; values exceeded .95 for all component pairs with the exception of those factors best representing virtue, which demonstrated fair similarity with a congruence level of .94.

STUDY 2

METHOD

Participants and Design

Continuing on from the previous study, we further explored the reliability and validity of the CCS in a separate UK-based population. Although the responsibility scale and a number of additional items were found to be problematic in the previous study, for the purpose of completeness we continued with the full 60-item measure. This also allowed us to corroborate whether similar problems arose when carrying out additional psychometric analyses.

Participants were recruited via advertisements inviting them to participate in a two-part online questionnaire, with the chance to win £25 (\$40) of shopping vouchers. Part one included a series of online questions and assessments designed to assess personality and recent health behaviours (described below). Participants who completed part one were sent an email invitation 2 weeks later, asking them to complete the CCS a second time, to assess test-retest reliability.

A total of 118 participants completed part one of the online validation study; 101 (85.6%) females and 17 (14.4%) males. Due to a technical error, information regarding

participants' age was not collected at the time of testing; 69 (58.5%) participants later gave their age online when requested via email invitation. The mean age of the 69 participants who retrospectively reported their age was 26.25 years (8.82 SD), with a range of 19-54 years.

Eighty participants completed part two of the study, on average 14.76 (SD 1.29) days after part one (range 14-19 days), giving a follow up rate of 67.8%. Comparing those participants lost at follow-up to those who completed all parts of the study, no significant differences were found for gender ($\chi^2 (1) = 2.01, p = .157$) or whether participants were students or in employment ($\chi^2 (2) = 2.69, p = .261$). Additionally, the two groups did not differ in terms of conscientiousness when measured using the CCS ($d = .24, p = .19$), or the IPIP conscientiousness scale ($d = .21, p = .26$). Those participants who reported their age retrospectively were significantly more likely to have completed all parts of the study ($\chi^2 (1) = 42.06, p \leq 001$); age data was available for 91.3% of the test-retest sample compared to only 58.5% of the whole sample. Therefore, we could not analyse whether the two groups differed on age.

Measures and Assessments

Participants responded to a range of questions assessing various health behaviours, and completed a series of assessment tools designed to measure personality traits.

Personality

Chernyshenko Conscientiousness Scales. The CCS, as described in Study 1, was administered to assess conscientiousness.

'Big 5' Personality Traits. The five broad personality domains (Extraversion, Agreeableness, Conscientiousness, Neuroticism and Openness to Experiences) were assessed using a 50-item International Personality Item Pool measure (IPIP; <http://ipip.ori.org/newNEODomainsKey.htm>). This public domain inventory is made up of five 10-item scales, each measuring constructs similar to those in the NEO-PI-R (Costa &

McCrae, 1992), with five positive and five negatively worded items per scale. Each scale has been to shown to correlate highly with the corresponding NEO-PI-R scale ($r = .77$), and has demonstrated good internal reliability with coefficient alpha's ranging from .77 to .86 (http://ipip.ori.org/newNEO_DomainsTable.htm).

Health Behaviours

The following health behaviours (risk taking behaviour, alcohol intake, tobacco consumption and drug use) were assessed cross-sectionally as outlined below. For each question participants were asked to think about their health behaviours on average over the past week.

Risk-Taking Behaviour was measured using four items taken from the Health Behaviour Checklist (HBCL; Vickers, Conway, & Hervig, 1990). Two items related to risky driving behaviour; "I speed while driving" (item 33) and "I carefully obey traffic rules so I won't have accidents" (item 12). The other items related to taking risks in daily life; "I take chances when crossing the street" (item 5) and "I engage in activities and hobbies where accidents are possible" (item 40). Participants rated all four items on a 5-point scale ranging from 1 (very uncharacteristic of me) to 5 (very characteristic of me), with item 12 being reverse scored.

Alcoholic beverage consumption was assessed using a number of questions adapted from the National Health Service (NHS) choices: alcohol self-assessment questions (NHS, 2013). This included an open response question in which participants were asked how many units of alcohol they had drunk over the past week. NHS guidelines on the unit equivalent of alcoholic drinks were provided so participants could calculate approximately how much alcohol they had consumed. To assess binge drinking participants were asked to indicate how often they consume six or more units on one occasion (ranging from never to

daily/almost daily), and on how many days in the past week have they consumed six or more units (ranging from never to 4 or more days).

Cigarette use was measured by asking participants to indicate whether they currently smoke tobacco and participants could indicate yes, no or that they smoked in the past. Participants were also asked to indicate how many cigarettes they had smoked in the last 7 days with a free response format.

Drug use was measured by asking participants to indicate how often they use drugs other than those required for medical reasons (ranging from never to often). To clarify what was meant by drug use, the following definition taken from the Drug Abuse Screening Test (Gavin, Ross, & Skinner, 1989) was provided; “this may include but is not limited to: cannabis (e.g., marijuana, hash), solvents (e.g., gas, paints), tranquilizers (e.g., Valium), barbiturates, cocaine and stimulants (e.g., speed), hallucinogens (e.g., LSD) or narcotics (e.g., Heroin). This does not include alcohol or tobacco.”

Statistical analysis

To assess convergent and divergent validity, participants’ scores on the CCS were correlated with the IPIP big five measure. For this to be confirmed, generally the CCS should correlate strongly with the broad measure of conscientiousness ($>.5$) whilst only demonstrating small or negligible correlations with the other four personality domains ($<.3$). However, as the IPIP measure is designed to measure the NEO-PI-R facets, based on the findings of Roberts et al. (2005), we expected conscientiousness to correlate strongly with the industriousness facet scale and less so with virtue, traditionalism and responsibility facet scales. To examine criterion-related validity, the total CCS score and the individual scales were correlated with important health behaviours. Pearson’s Product Moment Correlations were also run to examine the test-retest reliability of the CCS.

RESULTS

Descriptive Statistics

Mean CCS scores and the zero order correlations between the facet scales are given in Table 3. Replicating Study 1, participants scored highest on industriousness and responsibility, and lowest on traditionalism. With the exception of virtue, small to moderate associations were found between all facet scales. This suggests that although conceptually related, the scales measure a diverse set of lower order personality traits. However, the absence of a significant correlation between virtue and three of the other scales (industriousness, order and self-control) may indicate that for this UK population, being virtuous differs markedly from other aspects of conscientiousness. As a whole the sample was found to be relatively healthy, reporting low alcohol unit consumption and tobacco usage over the past week. Additionally, only a small number of participants were found to use drugs regularly or consume six or more units for most of the week. Descriptive statistics for the IPIP big five domain scales and participants' self-reported health behaviours scores are provided in the online appendices (Table 3).

Convergent and Divergent Validity

Table 4 presents a matrix of participants' scores on the CCS correlated with the IPIP Big Five scales. The total CCS score showed a strong correlation with the IPIP conscientiousness scale, $r = .63$, 95% CI [0.53, 0.72], indicating that the two measures converge. Although the CCS was found to relate significantly to the broad neuroticism, $r = -.21$, 95% CI [- 0.38, - 0.05], and agreeableness measures, $r = .22$, 95% CI [0.04, 0.38], these coefficients were less than .30, confirming divergent validity. Taken together, these findings show that as a whole the CCS demonstrates sound convergent and divergent validity.

Examining the facet scales individually, order, responsibility and industriousness all converged with the IPIP conscientiousness scale, with coefficients of .52, 95% CI [0.37,

0.66], .61, 95% CI [0.49, 0.72] and .55, 95% CI [0.42, 0.67]. These three scales also evidenced divergent validity; although they all correlated with the IPIP extraversion scale, and industriousness demonstrated a weak relationship with agreeableness, none of these coefficients exceeded .30.

Alternatively, the traditionalism and self-control facet scales demonstrated comparable weak-to-moderate correlations with several of the broad domain measures, including conscientiousness. Traditionalism was found to show the largest correlation with openness to experience ($r = -.36$, 95% CI [-0.51, -0.18]); however, this coefficient is still moderate, and does not indicate that the traditionalism facet is akin to this alternative domain scale. Similar-sized coefficients, ranging from $-.27$ to $-.32$, were also found between self-control and the IPIP conscientiousness, extraversion and openness scales. Likewise, this suggests that self-control is still relatively divergent from the other personality domains, but also does not converge with the IPIP measure of conscientiousness.

As expected, the virtue scale showed no significant relationship with the IPIP measure of conscientiousness, $r = .06$, 95% CI [-0.10, 0.22]. A significant correlation was found with agreeableness, $r = .23$, 95% CI [0.05, 0.40], but again this coefficient was weak in magnitude, indicating that the virtue scale measures a construct that is not captured by the IPIP domain scales.

Criterion-Related Validity

Table 5 shows the relationships between each of the facet scales and the health-related outcome measures. In addition, the correlations between the IPIP conscientiousness measure and the same health behaviours are also provided, therefore the criterion-related validity of both measures can be compared.

The total CCS score was found to correlate significantly with all health behaviour variables with the exception of risky activities. However, risky activities significantly

correlated with the self-control scale, $r = -.27$, 95% CI [-0.42, -0.09]. In addition, the total CCS score demonstrated equivalent or stronger relationships with the health behaviours than the broad IPIP measure indicating better criterion-validity.

Examining the individual facet scales in turn, each was associated with a minimum of one health behaviour. Self-control demonstrated the strongest relationships with most of the outcome measures, and often demonstrated an equal or larger coefficient than the global CCS score. Order also performed reasonably well, negatively correlating with the total risk behaviour score, $r = -.21$, 95% CI [-0.41, -0.00], recent binge drinking behaviour, $r = -.21$, 95% CI [-0.39, -0.08], and smoking status, $r = -.31$, 95% CI [-0.46, -0.13]. The industriousness facet scale showed the poorest validity, only weakly correlating with recent binge drinking, $r = -.18$, 95% CI [-0.37, -0.04].

Test-retest Reliability

Test-retest reliability was evaluated using data from 80 participants who completed the CCS approximately 2 weeks apart. The correlations between scores at time 1 and time 2 were high for all facet scales, indicating good test-retest reliability; Order ($r = .90$, 95% CI: 0.85, 0.94), Virtue ($r = .80$, 95% CI: 0.69, 0.89), Traditionalism ($r = .86$, 95% CI: 0.76, 0.92), Self-control ($r = .85$, 95% CI: 0.77, 0.91), Responsibility ($r = .81$, 95% CI: 0.70, 0.88), Industriousness ($r = .86$, 95% CI: 0.76, 0.92), and the total CCS score ($r = .87$, 95% CI: 0.79, 0.92). The complete correlation matrix can be found in the online appendices (Supplementary Table 4).

DISCUSSION

The Chernyshenko Conscientiousness Scales is a set of six related, yet individual scales, designed to assess the various ways in which one can be conscientiousness. It is widely acknowledged that measuring conscientiousness at the facet level can increase predictive validity (Bogg & Roberts, 2004; MacCann, Duckworth, & Roberts, 2009; Moon,

2001), however, existing faceted measures of conscientiousness do not encapsulate all of the lower order traits that have been associated with the domain (Roberts et al., 2014). Therefore, the CCS was developed with the intent to capture the entire breadth of conscientiousness, based on the comprehensive factor structure identified by Roberts et al. (2005). The current research aimed to evaluate the CCS to examine whether it is appropriate for use in US and UK-based populations, and two studies were carried out to meet this objective. In Study 1, internal reliability and factor analyses were performed on two large data sets. In Study 2, a separate validation sample was recruited to explore the scale in relation to test-retest reliability, convergent and divergent validity and criterion-related validity.

Principal axis factoring revealed the CCS to have a comparable factor structure across two samples, indicating that as a whole the scale performs consistently when administered to US and UK-based participants. For the most part, those items designed to measure industriousness, order, self-control, traditionalism and virtue, loaded as expected onto five distinct factors. These five scales also demonstrated good internal reliability, indicating that items within each scale measure a related construct. However, we have highlighted a number of items that reduce the reliability and validity of the measure, and a subset of items that are more problematic when administered to a UK sample, possibly as a result of cross-cultural differences. Therefore, we advise that any future revisions of the scale should either refine or remove these items from the measure, in order to improve its psychometric properties.

The most evident finding from study 1 was the short-comings of the responsibility scale. It was consistently found to have the lowest internal reliability and did not hold up as a coherent construct when subjected to factor analysis. However, contrary to expectation, in study 2 the scale demonstrated a strong relationship with the IPIP conscientiousness measure. This goes against Roberts et al. (2005), who found the NEO-PI-R to not capture responsibility. It is apparent from inspecting the content of the individual items that they

assess a range of qualities that are conceptually linked to conscientiousness, including being punctual, trustworthy and reliable. Therefore, in its current form, the responsibility scale may be a more broad measure of conscientiousness, tapping into multiple lower order traits, reflected by its strong relationship with industriousness. Nevertheless, the current set of items need to be extensively revised if the scale is to include a valid measure of the lower order facet of responsibility that has consistently emerged in research identifying the underlying structure of conscientiousness (Peabody & De Raad, 2002; Roberts et al., 2005; Saucier & Ostendorf, 1999).

The traditionalism and virtue scales were also found to show complex construct validity. These scales did not demonstrate a strong relationship with the IPIP conscientiousness measure, however, as previously noted, traditionalism and virtue are largely unrepresented in the NEO-PI-R, which our choice of comparison scales were based on (Bogg & Roberts, 2004; Roberts et al., 2005). Therefore, an alternative interpretation is that the lack of convergent validity confirms that the CCS captures lower order personality traits that are not assessed by existing faceted measures.

It could also be construed from our findings that the traditionalism scale measures a blend of several big five domains, or is a better fit as a marker of openness to experience. However, this overlap is not unprecedented. Lexical and empirical research exploring the underlying structure of conscientiousness has found similar correlations between traditionalism and openness to experience (Roberts et al., 2004; Roberts et al., 2005), and it has been argued that only those facets akin to order, industriousness and self-control are thought to be exclusively conscientiousness (MacCann et al., 2009). Furthermore, circumplex models of personality (i.e. AB5C; Hofstee et al., 1992) recognise the overlapping nature of the big five, and many of the respective facets used to assess subcomponents of any given domains. Therefore, our results are in line with previous interpretations that some facets

should be considered “interstitial dimensions” because they fall between conscientiousness and other five-factor model dimensions (Roberts et al., 2005, pp. 132). However, the absence of a salient relationship between virtue and any of the IPIP domain scales is also in agreement with the HEXACO model of personality, which proposes a unique Honesty-Humility dimension in addition to the traditional five factors (Lee & Ashton, 2004). Although the full breadth of the honesty-humility domain is not analogous to virtue, there are notable similarities between the fairness facet as described by Ashton and colleagues, and the qualities the virtue scale was designed to measure. Additionally, virtue has not consistently emerged in research that has attempted to identify the lower order structure of conscientiousness (MacCann et al., 2009). An important area for future investigation is to clarify which facets are at the core of conscientiousness and which are related, but may be better represented as a combination of personality domains. Furthermore, in future versions of the CCS, a distinction ought to be made between those scales that measure purely conscientiousness domains, and those that capture interstitial facets.

It is surprising that self-control did not demonstrate a stronger relationship with the IPIP conscientiousness measure given that the deliberation facet of the NEO-PI-R has been found to tap into self-control (Roberts et al., 2005). Instead, the relationship between self-control and the broad conscientiousness domain was comparable to the small negative associations found with extraversion and openness. Again, this absence of convergent validity may be due to our inclusion of a broad comparison measure that may over represent those facets similar to order and industriousness and overlook deliberation. This is supported by tests of criterion-related validity, in which self-control was often found to demonstrate significant relations with health-related behaviours, whereas the IPIP measure was found to be unrelated.

As expected, due to the proactive and inhibitive aspects of conscientiousness, variation was also found between the facet scales in regards to criterion-related validity. Most of the effect sizes reported in the current study are comparable to those described in an influential meta-analysis that found conscientiousness to be an important predictor of health-related behaviours (Bogg & Roberts, 2004). Furthermore, our pattern of findings largely replicates the aforementioned research, with self-control demonstrating the most consistent and salient concurrent relations and industriousness generally showing small or negligible associations. Again, our findings are likely to be heavily influenced by our choice of outcome measures. Industriousness reflects the degree to which one is hard working and ambitious, and it has demonstrated good predictive utility when correlated with objective academic-related outcomes (MacCann et al., 2009). Therefore, further research would benefit from drawing associations between the facet scales and a range of behavioural measures, in order to gain a better idea of their criterion-related validity. It would be interesting to explore the extent to which these conscientiousness scales relate to approach health behaviours such as exercise and healthy eating as well as to avoidance, risky behaviours as observed in the current study (Conner & Abraham, 2001; O'Connor et al., 2009). Moreover, researchers ought to investigate the associations between these scales and different health behaviours in adolescents in addition to adults (cf., Hagger-Johnson et al., 2012).

A number of limitations of the current study require some additional comment. First, we recognise that the main design was cross-sectional and as a result we are unable to draw any causal conclusions about the ability of the CCS to predict changes in behaviour overtime. Second, we acknowledge that the sample size recruited in Study 2 was relatively small, and consequently, the study may have been under powered to detect relationships between some of the lower order facets and the health behaviours. However, it is important to note that many relationships were observed, therefore, the absence of effects is likely to indicate a real

finding and that the lower order facets of conscientiousness have differential effects on health behaviours (Bogg & Roberts, 2004; O'Connor et al., 2009). A third limitation is that we did not collect data for an existing faceted measure, in addition to the CCS. The decision to include a shorter, broader measure of conscientiousness was made to reduce fatigue effects and increase response rates. However, as a result we are unable to draw any solid conclusions about how the CCS may map onto existing faceted measures. Therefore, we recommend that any future evaluation of the CCS include for example, the NEO-PI-C or the HEXACO-C, in order to provide a more meaningful comparison.

As already noted, our choice of outcome measures may also have led to underestimations in the degree to which conscientiousness facets associated with health-related behaviours. Due to the scope of the current research, we were only able to use retrospective self-report measures that are susceptible to inaccurate reporting and socially desirable responding. Such effects can be observed in the current research; criterion-related validity was higher for measures less susceptible to memory biases (e.g. 'Do you smoke?'), and associations were greater for those measures assessing the more recent past, for example, binge drinking within the last 2 weeks, compared to the more general measures. Therefore, future research ought to endeavour to objectively measure health behaviours, for example using breath carbon monoxide monitors or body-worn accelerometers, or use real-time measures of behaviour (e.g. daily diaries, experience sampling), to provide more accurate tests of the predictive utility of the CCS.

In conclusion, the findings of the current investigation show that those scales developed to measure order, virtue, traditionalism, self-control and industriousness are fairly robust and distinct, whereas the content and structure of the responsibility scale requires further study. With the exception of a few items, most of the 50 items cohered well into the expected five-factor structure and performed consistently across two separate populations.

Three items were more problematic when administered to a UK sample and require further refinement if the scale is going to be suitable for use in multiple populations. Additionally, empirical research is required to confirm virtue's status as a lower-order facet of conscientiousness. However, with further development, the Chernyshenko Conscientiousness Scales has the potential to be a useful alternative to the faceted measures of conscientiousness already available in the public domain.

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Table 1

Study 1: Descriptive statistics, internal consistency reliabilities, and zero order correlations between the facet scales for the CCS

Facet ^a	Mean ^b	SD	α	ORD	VIRT	TRAD	SC	RESP	IND
US (n=7569)									
Order	28.30	6.88	.90	-					
Virtue	28.71	5.81	.81	.28	-				
Traditionalism	26.17	5.54	.81	.39	.49	-			
Self Control	29.31	5.55	.82	.35	.38	.34	-		
Responsibility	31.60	4.47	.72	.42	.54	.40	.42	-	
Industriousness	31.83	5.50	.86	.42	.44	.34	.34	.66	-
UK (n=649)									
Order	35.52	8.12	.88	-					
Virtue	34.82	6.12	.77	.18	-				
Traditionalism	31.69	5.76	.74	.30	.40	-			
Self Control	34.70	6.82	.84	.33	.32	.37	-		
Responsibility	38.58	5.23	.70	.41	.46	.31	.40	-	
Industriousness	39.35	6.66	.87	.39	.43	.34	.32	.61	-

All inter-correlations have a significance value of $p < 0.001$.^aIND = Industriousness; ORD = Order; VIRT = Virtue; TRAD = Traditionalism; SC = Self Control; RESP = Responsibility^b For the US sample a response scale of 1-4 was adopted, whereas in the UK sample a response scale of 1-5.^c Listwise deletion applied for descriptive statistics and zero order correlations; n for internal consistency reliabilities ranged from 7589 to 7620

Table 2

Study 1: Results of Parallel Analysis and the Maximum Average Partial Test

	No. of Items	Excluded Items	Number of Factors	
			PA	MAP
US	60	-	9	6
	58	SC9; RESP5	9	6
	55	SC9; TRAD9; RESP5; RESP7; RESP10	7	6
UK	60	-	8	5
	55	SC9; TRAD9; RESP5; RESP7; RESP10	5	5

Table 3

Study 2: Descriptive statistics and zero order correlations between facet scales

Facet	Range	Mean	SD	α	IND	ORD	VIRT	TRAD	SC	RESP
CCS										
Industriousness	22-50	39.47	6.55	.85	-					
Order	14-50	34.20	8.90	.90	.31^a	-				
Virtue	17-50	34.32	6.29	.75	.09	.01	-			
Traditionalism	15-44	30.69	6.27	.76	.26	.18	.38	-		
Self Control	16-47	35.39	6.70	.83	.19	.25	.09	.30	-	
Responsibility	23-49	38.19	5.37	.68	.49	.38	.24	.27	.18	-
Total	145-262	212.27	23.25			.				

^a Bold text denotes correlation is significant at the 0.05 level (2-tailed)

Table 4

Study 2: Pearson's Product Moment Correlations between scores on the CCS and the IPIP scales.

Big Five Domains	Conscientiousness Facets						CCS Total
	Order	Virtue	Traditionalism	Self Control	Responsibility	Industriousness	
Conscientiousness	.52^a	.06	.22	.29	.61	.55	.63
Neuroticism	-.11	-.12	-.21	-.14	-.11	-.09	-.21
Extraversion	.22	-.00	.11	-.32	.28	.20	.14
Openness	-.03	.03	-.36	-.27	-.02	.14	-.14
Agreeableness	-.04	.23	.27	.12	.10	.19	.22

^a Bold text denotes correlation is significant at the 0.05 level (2-tailed)

Table 5

Study 2: Pearson's Product Moment Correlations between the CCS, IPIP and Criterion Variables

	ORD	VIRT	TRAD	SC	RESP	IND	TOTAL CCS	IPIP
Risk taking	-.21^a	-.19	-.18	-.45	-.10	.13	-.36	-.21
Speeding	-.10	-.16	-.15	-.37	-.07	-.14	-.27	-.11
Chance Taking	-.15	-.13	-.18	-.36	-.04	-.13	-.28	-.16
Obeying Traffic Rules	.23	.15	.11	.23	.10	.05	.25	.14
Risky activities	-.10	-.07	-.05	-.27	-.05	-.02	-.16	-.16
Alcohol								
Unit consumption	-.15	-.05	-.19	-.25	0.12	-.13	-.25	-.16
Binge drinking	-.16	-.01	-.16	-.22	-.15	-.06	-.21	-.22
Recent binge drinking	-.21	-.19	-.26	-.28	-.21	-.18	-.37	-.28
Substance use								
Do you smoke?	-.31	-.11	-.23	-.35	-.23	-.06	-.36	-.22
Cigarettes smoked in the last week	-.21	-.15	-.08	-.07	-.21	-.06	-.22	-.08
How often do you use drugs?	-.12	-.23	-.19^b	-.21	.01	.04	-.21	-.15

^a Bold text denotes correlation is significant at the 0.05 level (2-tailed)

^b Correlation coefficient when traditionalism was re-scored eliminating the item 'I believe that people should be allowed to take drugs, as long as it doesn't affect others'.