LOWER ORDER STRUCTURE OF CONSCIENTIOUSNESS AND THE PREDICTION OF HEALTH BEHAVIORS

BY

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THESIS

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ABSTRACT

The relationship between the personality trait of conscientiousness and health behaviors has been studied almost exclusively at the global level of analysis linking overall conscientiousness with health behaviors. In a series of studies, we examined the relation between the lower-order facets of conscientiousness and health behavior using meta-analyses, comprehensive statistical models, and multiple methods, which have not been used systematically in past research. The meta-analytic findings indicated that the self-control, industriousness, and conventionality facets were most strongly related to risky and preventative health behaviors. We next used Bi-factor models, that simultaneously modeled the latent conscientiousness factor along with the specific underlying facets, to test the incremental validity of facets. Across multiple data sets using both self and peer-reported personality measures the self-control facet consistently showed incremental validity above and beyond global conscientiousness.
To My Mother and Father
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CHAPTER 1

INTRODUCTION

Conscientiousness describes a person’s tendency to be planful, goal oriented, to delay gratification, and to follow socially prescribed norms and rules regarding self-control (Roberts et al., 2009). In numerous studies the personality trait of conscientiousness has been shown to predict health and longevity (Hill, Turiano, Hurd, Mroczek, & Roberts, 2011; Roberts, Walton, & Bogg, 2005). For example, in a 40-year prospective longitudinal study, teacher-rated childhood conscientiousness predicted less smoking, better overall adult self-rated health, and in women, lower body mass index scores 40 years later (Hampson et al., 2007). In addition, meta-analytic studies have shown a reliable positive relation between conscientiousness and longevity (Kern & Friedman, 2008; Roberts et al., 2007).

One of the primary pathways from conscientiousness to better health and longevity is through health behaviors (Hampson, 2007; Hill & Roberts, 2011; Lodi-Smith et al., 2010). Global measures of conscientiousness predict most, if not all of the health behaviors associated with premature mortality (Bogg & Roberts, 2004). Although the consistent nature of this finding is impressive, several methodological issues have not been adequately addressed in previous research linking conscientiousness to health behaviors. First, no research has used measures explicitly designed to assess the lower order structure of conscientiousness in order to determine which specific components of conscientiousness, or facets, are more or less responsible for the relation. Second, to our knowledge no studies have used formal structural equation methods to test whether facets predict health behaviors better than global conscientiousness. Finally, researchers have yet to examine facets using multiple measurement modalities (e.g., self-reports,
observer-reports), in order to test whether the same facets are the best predictors of outcomes across different methods.

In the current series of studies we address each of these issues directly. First, we report a meta-analytic summary of seven studies that used measures of conscientiousness created explicitly to assess the replicable lower-order facets of conscientiousness. Second, we used bi-factor analysis (Brouwer, Meijer, Weekers, & Banake, 2008; Chen, West & Sousa, 2006) to formally test whether variance captured at the facet-level of assessment provides incremental predictive validity above and beyond the general latent trait of conscientiousness. Third, we tested both the explicit measurement of conscientiousness and the bi-factor predictive validity patterns when using observer ratings rather than self-reports of conscientiousness.
CHAPTER 2
LITERATURE REVIEW

2.1 Lower-Order Structure of Conscientiousness and the Prediction of Health Behaviors

Past research has shown that narrower, more fine-grained assessments of personality traits could presumably have higher predictive validity with respect to specific behavioral outcomes (Ashton et. al., 1995, Paunonen & Ashton, 2001). With the promise of enhanced predictive accuracy, several investigations have been made into the lower order structure of conscientiousness. Researchers have investigated this possibility by testing which conscientiousness facets manifest both when using trait adjectives across self- and observer-reports (Roberts, Bogg, et al., 2004), as well as when factor analyzing scales related to conscientiousness drawn from major personality inventories (Roberts, Chernyshenko, et al., 2005). Five facets replicated across these two studies: orderliness, industriousness, reliability (or responsibility), conventionality, and self-control. Orderliness reflects the tendency toward being highly organized and punctual. Industriousness reflects the tendency to be tenacious and persistent in achievement-related activities. Responsibility is the propensity to follow through with promises to others and fulfill obligations. Conventionality reflects a tendency to be traditional and endorse social norms. Finally, self-control is the propensity to be cautious and anticipate future consequences of one’s actions.

For a variety of reasons, most of the research to date linking conscientiousness to health outcomes has examined overall measures of conscientiousness and not its constituent facets. For example, in some cases, large-scale studies lacked the time or resources to administer a longer scale (e.g., Friedman et al., 1993; Mroczek et al., in press). In one health behavior study the structure of conscientiousness was used to conceptually organize existing personality scales into
these five domains (Bogg & Roberts, 2004). Nonetheless, this study did not use any measures explicitly designed to measure each of the replicable facets of conscientiousness. Given the loose relationship between conceptual categorizations of existing scales and the specific facets they are proposed to measure, these results cannot be used to draw definitive conclusions about the differential validity of the lower-order facets of conscientiousness. In the present series of studies we address this omission by using two recently developed scales designed to capture the lower-order structure of conscientiousness: the Chernyshenko Conscientiousness Scales (CCS; Chernyshenko, 2003 Roberts & Hill, 2011) and the Conscientiousness Adjective Checklist (CAC; Jackson et al., 2009).

2.2 A Bi-Factor Analytic Approach to Testing the Significance of the Lower-Order Facets of Conscientiousness

The assumption that using specific facets will improve the predictive validity of personality measures is intrinsically compelling, but seldom rigorously tested. Typically, researchers examine correlations between facets and outcomes and identify the “best” facet based on the differential magnitude of these specific correlations. Unfortunately, in previous research the differences between the magnitudes of different correlations were seldom formally tested, nor were the incremental validities of narrow measures tested over and above that of the shared variance of the broad latent dimension. The difficulty with the typical approach is that the variability in the validity of specific facets could be attributed to several factors. First, it could be attributed to irrelevant unique variance. Specific facets may contain idiosyncratic items that overlap more concretely with an outcome, but are not strongly related to the latent construct used as a predictor. Second, it may result from relevant unique variance. The inference that a facet measure is a better predictor is predicated on the existence of systematic uniqueness
assessed by the facet scale that is not shared with the latent trait underlying the facet measure. For a facet level measure to have useful incremental validity, it must have a variance component that is both unique, and conceptually related to the broader construct the facet is derived from. However, when facet level measures are used, their common variance component is typically not removed. Zero-order associations of facets with outcomes of interest may simply reveal that a specific facet is a strong indicator of the broader latent trait. For example, if conventionality is the strongest predictor of drug behaviors and also has a high loading on the latent trait of conscientiousness, then an apparently large zero-order association with drug behaviors could be attributed to the latent trait and not the conventionality facet of conscientiousness.

One way to rigorously test whether lower-order facets improve predictive validity is to model the latent factor of conscientiousness and then test whether the variance specific to each facet predicts an outcome above and beyond the latent trait. Bi-factor analysis provides one of the more parsimonious approaches to achieve this aim (Rindskopf & Rose, 1988). In bi-factor analysis, one models the latent dimension, in this case conscientiousness, as the underlying cause of the various facets of conscientiousness. In addition, the facet is specified as a second latent trait that also describes the variance in the manifest indicators and is modeled as independent of the latent trait of conscientiousness. As an example, Figure 1 shows the bi-factor model used to test whether the self-control facet predicts risky health behaviors above and beyond the latent trait of conscientiousness. This structure allows one to test the effects of the facet that are independent of the latent global trait.

Factor analysis using bi-factor models was first popularized in educational psychology (Holzinger & Swineford, 1936), and the analytical method was next utilized to describe patterns in physiologically based psychological and psychiatric research (Curtis 1949; Richards & Nelson
1939; Wenger 1938). The technique is still used most extensively in these sub-fields of psychology. More recently, personality researchers have been applying bi-factor models to gain insight into the structure of personality scales, and to model complex hierarchical scenarios (Reise, Moore, & Haviland, 2010; Rushton & Irwing, 2009; Thissen et. al., 1994). Bi-factor models allow modeling of a univariate solution to a set of items, (the shared variance representing the broad latent trait) while simultaneously modeling the facet level structure of a set of items, (the unique variance of each facet of a measure) (Reise, Moore, & Haviland, 2010). By applying a bi-factor model when testing the link between conscientiousness and health behavior, we attempt to more rigorously examine whether facets provide additional validity in the prediction of health behaviors.

2.3 Observer Ratings of Conscientiousness

Another advance made by the current work is to examine the facets of conscientiousness using observer ratings. Although the most common approach to measure conscientiousness is through the use of self-reports, the veridicality of self-reports is often questioned and alternate methods of assessment have been proposed (McCrae & Weiss, 2007). For example, self-reports have been complemented with observer ratings made by knowledgeable friends and family members (Vazire, 2006). This is not to say that observer reports are interchangeable with self-reports. As demonstrated in the Self-Other Knowledge Asymmetry (SOKA) model (Vazire, 2010), observer reports tend to complement self-reports in very specific conditions. For attributes, and to model complex hierarchical scenarios, self-reports tend to be more valid predictors. In contrast, when psychological features are highly evaluative, observer ratings tend to be more accurate. When a personality domain is both observable and low on evaluativeness, then these two methods appear to be more equivalent (Vazire, 2010).
Very few studies have employed multiple methods of assessing conscientiousness when predicting health outcomes. In one set of studies, Walton and Roberts (2004) demonstrated that the links between conscientiousness and substance abuse were similar across self and observer reporting methods. In addition, one study found that observer and self-reports were both positively related to self-reported physical health (Lodi-Smith et al. 2010). However, the importance of studying both self and observer reports was underscored by the differential pattern of relations these two methods evidenced with respect to preventative health behavior. Both self-reported and observer rated conscientiousness predicted risky health behaviors. However, self-reported conscientiousness was positively related to preventative health behaviors, but observer reports were uncorrelated with preventative health behaviors. Similarly, self-report, observer rated, and experimentally assessed variants of impulsivity predicted health outcomes differentially in a lab study of undergraduates (Edmonds et al., 2009). However, none of these studies systematically examined the facets underlying conscientiousness and whether the differential validity of self- and observer ratings was the result of differential validity at the facet-level of analysis. Accordingly, we re-analyzed the data from Lodi-Smith et al. (2010) to test whether the facet level specificity of conscientiousness and health behavior outcomes often seen in self-reports replicated in observer ratings. Moreover, we applied the bi-factor model to observer ratings to test the differential predictive validity in the same way as we tested in self-reports.

The present research aims to address several conceptual and methodological issues regarding the link between conscientiousness and health behaviors. In Study 1, we compiled seven data sets to test the zero-order relations between conscientiousness, its facets, and health behaviors using meta-analytic techniques. Study 2 built on these initial findings by employing
bi-factor analytic techniques to more rigorously test whether the facets of conscientiousness provide unique predictive value for health behaviors. Finally, Study 3 examined this question again using observer ratings of conscientiousness.
CHAPTER 3
STUDY 1

3.1 METHOD: Synthesis of Seven Studies

Over several years, we accumulated seven separate samples in which measures explicitly created to assess the lower-order structure of conscientiousness were assessed along with health behaviors. Rather than presenting the data from each of these studies separately, we chose to synthesize the results of the seven studies using meta-analytic techniques.

Samples

Sample 1. Study participants included 2136 adults (51% female) from across the United States. Participants ranged in age from 20 to 101 (M = 51.00, SD = 17.10) and self-reported ethnicity as 79% Caucasian, 9% African American, 7% Hispanic/Chicano/Mexican American, 5% Other or multiracial. Participants were recruited through a data collection service with the purpose of acquiring a randomized and representative sample. Surveys were completed online in return for $20 compensation.

Sample 2. Participants included 274 central Illinois residents (61% female) recruited from 2001 to 2003 through newspaper advertisements, flyers, and postings on a list-serve serving the employees and retired employees of a Midwestern University. Advertisements asked for volunteers who were willing to participate in interviews about their life and complete several surveys in return for monetary compensation. Participants completed the measures described below as part of a larger battery of questionnaires assessing personality, health, daily behaviors, and psychological well-being. Participants were reimbursed $8 to $10 an hour. Participants ranged from 19 to 94 years of age (M = 51.25, SD = 16.43) and were primarily Caucasian (88%).
Sample 3. Study participants included university students and their family members (total n = 592). Two hundred thirty-three university students (65% female) were recruited from an introductory psychology class. The family member sample included 359 participants (58% female). Students were requested to solicit participation from family members who were willing to complete several internet surveys in return for student course credit over the course of a semester. Participants completed the measures described below as part of a larger battery of questionnaires assessing personality, health, daily behaviors, and psychological well-being.

Student participants ranged from 18 to 34 years of age (M = 20.25, SD = 1.75), family member participants ranged from 40 to 68 years of age (M = 50.96, SD = 4.45) and self-reported ethnicity as 69.9% Caucasian, 17.3 % Asian American, 5.4% African American, 5% Hispanic/Chicano/Mexican American, 1.3% Native American, and 1.1% Other.

Sample 4. Study participants included 451 undergraduate students (66% female), recruited from an introductory psychology class. Participants ranged from 17 to 27 years of age (M = 18.75, SD = 1.15) and self-reported ethnicity as 75% Caucasian, 8% Asian American, 6% African American, 5% Hispanic/Chicano/Mexican American, 1% Native American, and 4% Other.

Sample 5. Study participants included 164 undergraduate students (63% female), recruited from an introductory psychology class. Participants ranged from 18 to 25 years of age (M = 19.10, SD = 1.19) and self-reported ethnicity as 70.1% Caucasian, 19.5 % Asian American, 4.9% African American, 4.9% Hispanic/Chicano/Mexican American, 0.6% Native American.

Sample 6. Study participants included 753 undergraduate students (69% female), recruited from an introductory psychology class. Participants ranged from 18 to 39 years of age (M = 19.74, SD = 1.89) and self-reported ethnicity as 77 % Caucasian, 7.9 % Asian
American, 6.5% African American, 5.3% Hispanic/Chicano/Mexican American, 0.2% Native American, and 3% Other.

Sample 7. Study participants included 432 undergraduate students (70% female), recruited from an introductory psychology class in New Zealand. Participants ranged from 17 to 59 years of age (M = 22.00, SD = 5.91) and were mostly of European/Western descent, which closely reflected the demographic composition of the region (89.3% Caucasian, 6.0% Asian, 1.7% Maori or Pacific Islander, and 3% Other).

**Measures**

*Personality measures*. Samples 1, 3, 5, 6 and 7 used the Chernyshenko Conscientiousness Scales (CCS; Chernyshenko, 2003; Hill & Roberts, 2011) with reliabilities ranging from $\alpha = 0.60$ to 0.92. The CCS was created based on an examination of the factor structure of 36 conscientiousness scales drawn from most of the personality inventories in current use, which revealed 6 factors (Roberts et al., 2005). We focused on the five factors that have replicated across multiple studies (self-control; reliability; orderliness; industriousness; & conventionality; Roberts, Bogg, et al., 2004; Roberts, Chernyshenko, et al., 2005). Samples 1, 5, 6 and 7 used the long 60-item form (10 items per scale), and sample 3 used the short 24-item form (4 items per scale) of the CCS to assess the conscientiousness facets. Facets assessed included self-control (“I am easily talked into doing silly things”) ($\alpha = 0.73$ to 0.80), reliability (“I carry out my obligations to the best of my ability”) ($\alpha = 0.60$ to 0.75), orderliness, (“I hardly ever lose or misplace things”) ($\alpha = 0.76$ to 0.92), industriousness, (“I do not work as hard as the majority of people around me”) ($\alpha = 0.81$ to 0.87), and conventionality, (“I do not intend to

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1 Individual Sample means, standard deviations and alphas for all scales are available upon request
follow every little rule that others make up”) (α = 0.72 to 0.79). All CCS items were rated on a four-point scale from 1 (Disagree Strongly) to 4 (Agree Strongly).

Samples 2 and 4 used the Conscientiousness Adjective Checklist (CAC; Jackson et. al., 2009) to assess the facets of conscientiousness. Participants in samples 2 and 4 rated conscientiousness adjectives on a five-point scale from strongly disagree (1) to strongly agree (5). Measures of the five replicable facets of conscientiousness were derived from these ratings: self-control (12 items, “careful”) (α =.75 and .68), reliability (7 items, “dependable”) (α = .77 and .81), orderliness (9 items, “neat”) (α = .82 and .84), industriousness (7 items, “thorough”) (α =.60 and .49), and conventionality (6 items, a sample item: “traditional”) (α = .64 and .64).

Health Behavior Measures. All seven samples completed the Health Behavior Checklist (HBC; Vickers, Conway & Hervig, 1990). Samples 1, 2, 4, 6 and 7 used the longer 40-item version of the HBC (reliabilities range α = 0.48 to 0.81), while Samples 3 and 5 used a shorter 26-item version (reliabilities range α = 0.46 to 0.78). Both versions contained the full complement of four scales intended to measure risky and preventative health behaviors significant to overall health and longevity. The HBC scales are comprised of three to ten items and were rated on a five-point scale of 1 (Disagree Strongly) to 5 (Agree Strongly). Participants in all seven samples rated themselves on the four subscales assessing the health-related behaviors of traffic risk (“I carefully obey traffic rules so I won’t have accidents” – reverse scored) (α = .66 to .79), substance use (“I don’t smoke” – reversed scored) (α = .46 to .64), wellness maintenance (“I see a doctor for regular checkups”) (α = .58 to .81), and accident control (“I learn first aid techniques”) (α = .61 to .73).

Samples 1 and 2 also assessed health-related behaviors using scales and items drawn from the Behavioral Risk Factor Surveillance System (BRFSS; National Center for Chronic
Disease Prevention and Health Promotion, 2000) and the Youth Risk Behavior Surveillance System (YRBSS; National Center for Chronic Disease Prevention and Health Promotion, 1999) (reliability range $\alpha = 0.56$ to 0.91). Participants in samples 1 and 2 rated themselves on eight behaviors: cigarette consumption (2 items, “During the past year, approximately how often did you smoke cigarettes?”) $^1$ ($\alpha = .84$ and .91), alcohol consumption (3 items, “During the past year, on average, how many days per week did you have at least one drink of alcohol?”) ($\alpha = .81$ and .83), illicit drug consumption (6 items, “During the past year, how often did you use marijuana or hashish?”) ($\alpha = .82$ and .56), violence (5 items, “During the past year, how many times were you in a physical fight?”) ($\alpha = .69$); 87% of sample 2 reported no experience of violence necessitating removal of scale from further analyses due to lack of base rate, risky driving (2 items, “During the past year, how many times did you drive a car or other vehicle when you had been drinking alcohol?”) ($\alpha = .81$ and .78), and suicidal ideation (2 items, “During the past year, how many times did you seriously consider suicide?”) ($\alpha = .89$ and .62); two items assessing suicide attempts were excluded due to low response rate, physical activity (3 items, “During the past year, approximately how many times per week did you exercise or participate in a physical activity for at least 20 minutes that made you sweat and breathe hard?”) ($\alpha = .77$ and .62), eating patterns (6 items, “During the past 7 days, how many times did you eat green salad?”) ($\alpha = .80$ and .64). Participants rated the frequency or quantity of activities within each domain comprised of 2 to 6 items. Items were averaged to form composite scores indicating greater or lesser frequency/quantity for each domain. In all scales (and all samples using the BRFSS/YRBSS).

$^1$ Two items assessing other tobacco product use and cigar smoking were excluded due to their low base rate resulting in low correlation with the other tobacco measures.
items were z-scored before the composite was computed because of different rating scales used for specific items.

Remaining consistent with our previous work using the HBC (Lodi-Smith et al., 2010), we combined the HBC wellness maintenance and accident control scales in samples 3, 4, 5, 6, and 7 (α = .83; .80; .76; .76; and .76 respectively), along with BRFSS physical activity and eating patterns scales in samples 1 and 2 (α = .80 and .89), into a preventative health behavior index. We also combined the HBC traffic risk and substance use scales in samples 3, 4, 5, 6, and 7 (α = .77; .78; .75; .73; and .68 respectively), together with BRFSS cigarette consumption, alcohol consumption, illicit drug consumption, experiences of violence, risky driving and suicidal ideation scales in samples 1 and 2 (α = .82 and .90), into a risky health behavior index. All scales were standardized using z-scores before combining them using the simple mean into the two subcategories of risky and preventative health behaviors.

Meta-analytic analyses

Using meta-analytic techniques, we calculated the summary correlations between conscientiousness and health behaviors, both at the global level of conscientiousness and facet level of conscientiousness. In the two studies that assessed both HBC and BRFSS health behaviors, subscales from both were used to create the overall risky and preventative health behavior ratings (see Table 1). However, as the BRFSS was only assessed in two studies, estimates of the between-study variance for this measure were necessarily less precise than for the HBC measure of health behavior, and thus we only analyzed the HBC measure at the subscale level.

We separately analyzed the correlation between conscientiousness and health behavior for each individual facet. To compare the correlations between facets, we compared correlation
magnitudes using Fisher’s r-to-z tests. Several of the meta-analysis models were homogeneous. However, the majority of the studies showed heterogeneity and all correlation parameters therefore are reported using a random-effects model. All parameters were estimated using the Comprehensive Meta-Analysis software package (Borenstein & Rothstein, 1999).

3.2 RESULTS

Table 1 shows the estimates of the correlations between the five replicable facets of conscientiousness, overall risky and overall preventative health behaviors\(^2\), and the four scales drawn from the HBC. Taking into consideration the 95% confidence intervals, each of the five facets of conscientiousness significantly predicted overall risky and preventative health behaviors and all of the HBC subscale health behaviors. These results partially replicated previous meta-analytic work on conscientiousness facets and health behavior (e.g., Bogg & Roberts, 2004) in two important ways. First, the propensity to adhere to conventional norms was on average the strongest predictor of all health behaviors and most strongly associated with risky health behaviors Rho = -0.35, although taking the 95% confidence intervals into consideration the relationship with the self-control facet Rho = -0.28; was equally strong. Second, the orderliness facet was on average the least highly correlated with health behaviors.

However, our findings in Study 1 showed two distinct differences from the past meta-analytic work. First, on average, the second most important predictors were industriousness and reliability, which stands in contrast to the previous work in which industriousness showed some of the lowest correlations. Second, although significant differences were evident between correlation coefficients, by and large, the facets evidenced strikingly similar relations with health behavior. Previous work evidenced greater heterogeneity in facet correlation magnitudes.

\(^2\) Overall risky and overall preventative health behavior composites include BRFSS scales.
perhaps resulting from the use of pre-existing measures of personality traits that were not
originally created to measure the facets of conscientiousness instead of using direct measures of
each facet as employed currently.

Table 2 shows the average correlation for the relationships between overall
consciousness scores (calculated as a composite of scores on the five facets), HBC and the
BRFSS health behavior measures. Overall conscientiousness correlated at least as strongly with
the health behavior outcomes as did the specific facet measures, as seen when comparing Table 1
and 2. The largest predictive relationship found between omnibus-conscientiousness and health
behaviors were for HBC traffic risk \( r = -0.34 \), and HBC accident control \( r = 0.34 \). However,
by and large, conscientiousness evidenced similar relations across the health behavior measures
(magnitude range: .23 to .34).

3.3 DISCUSSION

This meta-analytic study examined the relations between overall conscientiousness, its
facets, and health behavior, using measures intentionally designed to measure the lower-order
structure of conscientiousness. The findings were consistent with past research in several ways,
yet inconsistent in others. Specifically, consistent with previous meta-analytic research (Bogg &
Roberts, 2004), the conventionality facet was the best predictor on average of health behaviors as
determined by averaging the rho’s from each scale after applying the Fisher’s z transformation
(Borenstein et. al., 2009). On the other hand, the average correlation across facets was not as
variable as this past research. Also, generally, the best predictor of all possible health behaviors
was the composite conscientiousness scale. This finding contradicts a widely held psychometric
assumption that greater scale specificity will necessarily produce higher validity coefficients
(Paunonen & Ashton, 2001) and supports a more provocative line of reasoning suggesting that

global scales work best when predicting outcomes (Ones & Viswesvaran, 1996).

These meta-analytic findings substantiate the importance of overall conscientiousness for
predicting health behaviors. However, it remains unclear whether specific facets add any value
above and beyond a general measure of conscientiousness. In Study 2, we tested this idea more
formally by employing bi-factor analysis in three of the samples used above.
CHAPTER 4

STUDY 2

4.1 METHOD: Bi-Factor Models of Three Self Report Studies

Samples

Sample 1. Study participants included 2136 adults (51% female) from across the United States. Participants ranged in age from 20 to 101 (M = 51.00, SD = 17.10) and self-reported ethnicity as 79% Caucasian, 9% African American, 7% Hispanic/Chicano/Mexican American, 5% Other or multiracial.

Sample 6. Study participants included 753 undergraduate students (69% female), recruited from an introductory psychology class. Participants ranged from 18 to 39 years of age (M = 19.74, SD = 1.89) and self-reported ethnicity as 77% Caucasian, 7.9% Asian American, 6.5% African American, 5.3% Hispanic/Chicano/Mexican American, 0.2% Native American, and 3% Other.

Sample 7. Study participants included 432 undergraduate students (70% female), recruited from an introductory psychology class in New Zealand. Participants ranged from 17 to 59 years of age (M = 22.00, SD = 5.91) and were mostly of European/Western descent, which closely reflected the demographic composition of the region (89.3% Caucasian, 6.0% Asian, 1.7% Maori or Pacific Islander, and 3% Other).

Measures

**Personality Measures.** All three samples used the Chernyshenko Conscientiousness Scales to assess personality (CCS; Chernyshenko, 2003; Hill & Roberts, 2011) with reliabilities ranging from $\alpha = 0.66$ to 0.90.
Health Behavior Measures. Participants completed the 40 item Health Behavior Checklist (HBC; Vickers, Conway & Hervig, 1990) with reliabilities ranging from $\alpha = 0.48$ to $0.74$.

Sample 1 also assessed health-related behaviors using scales and items drawn from the Behavioral Risk Factor Surveillance System (BRFSS; National Center for Chronic Disease Prevention and Health Promotion, 2000) and the Youth Risk Behavior Surveillance System (YRBSS; National Center for Chronic Disease Prevention and Health Promotion, 1999) with reliability ranging from $\alpha = 0.69$ to $0.89$.

To retain consistency with our previous work using the HBC (Lodi-Smith et al., 2010), we combined the HBC wellness maintenance and accident control scales in samples 6 and 7 (composite $\alpha = .76$ and .76), along with BRFSS physical activity and eating patterns scales in sample 1 (composite $\alpha = .80$), into a preventative health behavior index. We also combined the HBC traffic risk and substance use scales in samples 6 and 7 (composite $\alpha = .73$ and .68), together with BRFSS cigarette consumption, alcohol consumption, illicit drug consumption, experiences of violence, risky driving and suicidal ideation scales in sample 1 (composite $\alpha = .89$), into a risky health behavior index. All scales were standardized using z-scores before combining them using the simple mean into the two subcategories of risky and preventative health behaviors.

Analyses

To determine whether lower order facets of conscientiousness add to the prediction of risky and/or preventative health behaviors above and beyond overall measures of conscientiousness, we utilized samples 1, 6 and 7 due to their use of the CCS, which is a dedicated conscientiousness facet measure (Chernyshenko, 2003). The relationship between
lower order facets of conscientiousness, risky and preventative health behaviors were analyzed using bi-factor analysis (see Figure 1). We parceled the items using an item-to-construct balancing approach to simplify the model, better adhere to the assumption of normality, and get more stable estimates (Holt, 2004; Little et. al., 2002). Every subscale contained three or four parcels of at least three items each. Items from each lower order sub-scale were grouped into 3 or 4 parcels based on the results of factor analysis applied to each data set independently such that each parcel included a minimum of 3 items. To create the parcels, factor loading items on the first un-rotated component of each facet were derived from a principal components factor analysis in SPSS, constrained to extract a single factor. Items were then assigned to each parcel serially based on factor loading wherein the item with the largest factor loading was assigned to parcel 1; second largest factor loading assigned to parcel 2 and so on. We assigned items to parcels serially using a distributive strategy to improve model fit (Little et al., 2002). A serial distribution strategy for parceling items is the most appropriate method when items are unidimensional (Little et al., 2002). The latent constructs described by items for facet level conscientiousness are both theoretically unidimensional, found to be empirically unidimensional in a factor analysis of these data sets,

We estimated risky and preventative health behaviors as latent variables. Health behavior subscales were used as indicators of the latent health behavior construct. Items were grouped into parcels based on the corresponding health behavior subscales. The overall risky health behavior measure included the substance risk and traffic risk HBC scales in samples 6 ($\alpha = 0.76$) and 7 ($\alpha = 0.68$). These risky health behavior items were supplemented with BRFSS/YBRSS cigarette consumption, alcohol consumption, illicit drug consumption, violence, risky driving, and suicidal ideation scales in sample 1 ($\alpha = 0.89$). The overall preventative health behavior measure
included the *accident control* and *wellness maintenance* HBC scales in samples 6 ($\alpha = 0.73$), and sample 7 ($\alpha = 0.76$). Sample 1 preventative health behaviors were again supplemented with BRFSS/YBRSS *physical activity* and *eating patterns* scales ($\alpha = 0.80$). All items were standardized using z-scores before combining them using the simple mean into the two subcategories of risky and preventative health behaviors. We used RMSEA and CFI fit indices to evaluate model fit.

4.2 RESULTS

First, we constructed a bi-factor model requiring the latent global trait of conscientiousness to load onto each of the 5 facet parcels. Simultaneously, we specified additional factors to load onto the facet parcels (see Figure 1). Across the three data sets, these models achieved acceptable levels of fit (CFIs from 0.93 to 0.97; RMSEAs from 0.04 to 0.06).

The top third of Table 3 shows the pattern of path coefficients from facet scales modeled as factors in the bi-factor model to health behaviors while simultaneously controlling for the effect of overall Conscientiousness on health behaviors in Sample 1. The bi-factor model tests whether the unique variance of the facet predicts health behaviors above and beyond what the shared variance of the latent factor of conscientiousness predicts. For reference, the path coefficient between overall conscientiousness and health behaviors in this sample was -0.48 for risky health behaviors and 0.53 for preventative health behaviors. In support of the argument that lower-order measures do contribute important variance beyond the global measures, the self-control ($\beta = -0.23$) and conventionality ($\beta = -0.36$) factors predicted risky health behaviors above and beyond the global trait of conscientiousness. Interestingly, industriousness ($\beta = 0.30$) and orderliness ($\beta = 0.06$) facets also predicted risky health behaviors above and beyond conscientiousness, but in a counterintuitive direction. With respect to preventative health
behaviors, we found that the conventionality ($\beta = 0.09$) and orderliness factors ($\beta = 0.14$) predicted preventative health behaviors above and beyond the latent factor of conscientiousness.

The counterintuitive results for specific subscales, such as industriousness, could be attributable to two possible causes. First, the global factor of conscientiousness may be accounting for all of the relevant variance that a trait would normally predict in the outcome, thus leaving only counterintuitive and potentially artifactual variance left to predict. Second, the global trait of conscientiousness may extract all the meaningful variance from the manifest indicators of the facet and therefore leave only artifactual variance for the facet constructs.

These alternatives can be teased apart through a variation on the bi-factor model. If overall conscientiousness is accounting for all of the meaningful variance in the outcome then eliminating the path from overall conscientiousness to the outcome and examining only the predictive relation between the facet and the outcome should reveal to what degree the facet level prediction is being attenuated. If the path from the facet becomes either nonsignificant or intuitive in direction, then the effect is attributable to the fact that overall conscientiousness is accounting for all the relevant variance in the outcome. If the path remains counterintuitive, then the facet may represent unique variance that is not conceptually relevant to contentiousness. This can occur if the facet carries a large common variance component. Since the bi-factor model removes this variance from the facet, unique variance in the facet might not be conceptually related to conscientiousness as traditionally defined.

After removing the path from conscientiousness to risky health behaviors in the bi-factor model, the counterintuitive relationship between industriousness and risky health behaviors remained significant, though attenuated ($\beta = 0.17$). This indicates that the industriousness facet likely overlaps so much with the global dimension of conscientiousness in
this sample that it cannot be meaningfully distinguished from the underlying latent trait. Removing the path to overall conscientiousness did however eliminate the counterintuitive relationship between orderliness and risky health behaviors, as well as that between industriousness and preventative health behaviors. Therefore it can be inferred that overall conscientiousness was accounting for all of the variance in the outcome relevant to these facets in Sample 1.

The middle third of Table 3 shows the path coefficients between the facet scales modeled as factors in the bi-factor model for Sample 6. For reference, the correlation between overall conscientiousness and health behavior in this sample was -0.49 for risky health behaviors and 0.36 for preventative health behaviors. In support of the argument that lower-order measures do contribute important variance beyond the global measures, the self-control ($\beta = -0.30$) and conventionality ($\beta = -0.30$) factors predicted risky health behaviors above and beyond the global trait of conscientiousness. We were unable to obtain an estimate of the relationship between risky health behaviors and the reliability facet in this sample, as little variance remained in the facet after controlling for that accounted for by the global trait. With respect to preventative health behaviors, we found that the industriousness factor ($\beta = 0.54$) predicted preventative health behaviors above and beyond overall conscientiousness. In this sample there were no counterintuitive findings.

The bottom third of Table 3 shows the pattern of correlations between the facet scales modeled as factors in the bi-factor model for Sample 7. For reference, the correlation between overall conscientiousness and health behavior in this sample was -0.29 for risky health behaviors and 0.29 for preventative health behaviors. In support of the argument that lower-order measures do contribute important variance beyond the global measures, the self-control ($\beta = -0.44$) and
conventionality ($\beta = -0.51$) factors predicted risky health behaviors above and beyond the global trait of conscientiousness. Interestingly, the orderliness ($\beta = 0.44$) and reliability ($\beta = 0.37$) facets also predicted risky health behaviors above and beyond conscientiousness, but in the counterintuitive direction. With respect to preventative health behaviors, we found that the orderliness factor ($\beta = 0.21$) predicted preventative health behaviors above and beyond the overall conscientiousness factor. We were unable to obtain an estimate of the relationship between preventative health behaviors and the industriousness facet in this sample due to over-fit of the model resulting in no remaining variance attributable to that facet. In this sample no counterintuitive relationships were observed among preventative health behaviors and the facets above and beyond overall conscientiousness.

Removing the path from overall conscientiousness to risky health behaviors eliminated the counterintuitive relations with respect to the orderliness and reliability facets in Sample 7. Because the paths were no longer significant it can be inferred that overall conscientiousness was accounting for all of the variance in risky health behaviors that was relevant to the orderliness and reliability facets in this sample.

4.3 DISCUSSION

In Study 2, we used bi-factor modeling to test the predictive validity of conscientiousness facets above and beyond the global trait of conscientiousness in three separate samples that used a self-report measure specifically designed to measure these lower-order facet constructs. In support of the argument that lower-order measures contribute important variance beyond the global measures, the self-control and conventionality facets predicted risky health behaviors above and beyond global trait of conscientiousness in all three samples. With respect to preventative health behaviors, the results were more varied, with one or more facet showing a
significant positive relationship in each sample, but no single facet evidencing a consistent relationship across all three samples. These results suggest that facet level assessment of conscientiousness could add unique information to the prediction of important health behaviors.

These results are provisional because they rely on a single method of assessment, self-reports, do measure both conscientiousness and health behaviors. In our third study, we examined whether similar results held across different formats for assessing conscientiousness and its facets. To address this question, we applied the bi-factor model technique to one data set in which facet-level conscientiousness was assessed through both self and observer reports (Study 3).
CHAPTER 5

STUDY 3

5.1 METHOD: Bi-Factor Model of Self and Observer Report Studies

Sample

Sample 2. Participants included 274 central Illinois residents (61% female). Participants ranged from 19 to 94 years of age (M = 51.25, SD = 16.43) and were primarily Caucasian (88%).

Measures

Self-Report Personality Measures. Sample 2 used the Conscientiousness Adjective Checklist (CAC; Jackson et. al., 2009) to assess the facets of conscientiousness with reliabilities ranging from $\alpha = 0.75$ to 0.82.

Health Behavior Measures. Participants completed the 40-item Health Behavior Checklist (HBC; Vickers, Conway & Hervig, 1990), with reliabilities ranging from $\alpha = 0.46$ to 0.77.

Sample 2 also assessed health-related behaviors using scales and items drawn from the Behavioral Risk Factor Surveillance System (BRFSS; National Center for Chronic Disease Prevention and Health Promotion, 2000) and the Youth Risk Behavior Surveillance System (YRBSS; National Center for Chronic Disease Prevention and Health Promotion, 1999), with reliabilities ranging from $\alpha = 0.56$ to 0.91.

As in studies 1 and 2, we combined the HBC wellness maintenance and accident control scales along with BRFSS physical activity and eating patterns scales (composite $\alpha = .82$), into a preventative health behavior index. We also combined the HBC traffic risk and substance use scales together with BRFSS cigarette consumption, alcohol consumption, illicit drug
consumption, experiences of violence, risky driving and suicidal ideation scales (composite α = .90), into a risky health behavior index.

Measures Novel to Study 3

**Personality - Observer rated conscientiousness.** Observer ratings were obtained in three ways. First, the majority of participants supplied contact information for one or more close associate (friends and family members). Close associates were contacted by phone and asked to complete a battery of measures including ratings of personality traits using the CAC (Jackson et al., 2009) in return for a small monetary reimbursement. Second, participants completed a structured McAdams Life Story Interview (McAdams, 1995) with a trained graduate student. The McAdams Life Story Interview asks participants to describe significant moments in their lives (e.g., high point, low point, and turning point), important characters in their life stories, their future goals, personal beliefs and values. After the completion of the interview, the interviewer rated the participant on the CAC. Third, after listening to recordings of the McAdams Life Story interviews, trained undergraduate students also rated the participant on the CAC. A total of 1,023 observer ratings were completed with a modal number of 4 ratings \( M = 3.70 \) per participant. Observer ratings were averaged together to form composite indices for each of the five facets of conscientiousness from the CAC: conventionality \( (M = 3.41, SD = 0.64, ICC = 0.46) \), reliability \( (M = 4.07, SD = 0.62, ICC = 0.46) \), self-control \( (M = 3.72, SD = 0.57, ICC = 0.68) \), orderliness \( (M = 3.58, SD = 0.57, ICC = 0.34) \), and industriousness \( (M = 3.53, SD = 0.52, ICC = 0.39) \). Interclass-correlation coefficient (ICC) reliability ranged from 0.67 to 0.89. Agreement between close associates, graduate interviewers, and student raters ranged from 0.21 to 0.35. Previous meta-analytic work on observer personality reports suggests that their
inter-rater reliabilities range from 0.30 to 0.45 (Connolly, Kavanah, Viswesvaran, 2007), indicating that the rates of agreement found in our study were similar to past research.

**Analyses**

All analyses were conducted as in Study 2. Health-related behaviors were parceled as in Study 1 and 2 (with the exclusion of violence-related behaviors due to low base rates in this sample).

5.2 RESULTS

As seen in Table 4, all observer-rated facets showed significant zero order relationships with both risky and preventative health behaviors. The strongest observer-rated predictor of risky health behaviors was self-control \((r = -0.42)\), although observer-rated orderliness \((r = -0.36)\), reliability \((r = -0.34)\), and conventionality \((r = -0.32)\) were also highly correlated with risky health behaviors. The strongest observer-rated predictor of preventative health behaviors was overall conscientiousness \((r = 0.31)\), followed by self-control \((r = 0.25)\) observer-rated orderliness \((r = 0.21)\), and conventionality \((r = 0.21)\). None of the facet level predictors showed significantly different correlations with risky or preventative health behaviors from that of overall conscientiousness.

**Bi-Factor Analyses**

As in Study 2, we next used bi-factor analysis to test more rigorously the predictive validity of conscientiousness facets above and beyond overall conscientiousness in the observer report data. Only the self-control facet showed a significant relationship with risky health behaviors in the expected direction \((\beta = -0.20)\) above and beyond the latent construct of conscientiousness (see Table 4). With respect to preventative health behaviors, the conventionality facet showed a relationship in the expected direction \((\beta = 0.22)\); however, the
industriousness facet evidenced a significant relationship in the counter-intuitive direction ($\beta = -0.31$). This facet maintained a significant relationship with preventative health behaviors above and beyond overall conscientiousness even after removing the path from overall conscientiousness to preventative health behaviors ($\beta = -0.29$). The persistent counterintuitive result indicates that the reliable variance in industriousness attributable to overall conscientiousness and that controlling for the overall C factor reduced the residual variance to something effectively different from conscientiousness.

5.3 DISCUSSION

In Study 3, we tested whether observer reports of conscientiousness also predicted health behaviors, and if so, whether facets added to the predictive value. Based on the magnitudes of the correlations, observer reports are a viable alternative to self-reports when predicting health behaviors. Using observer reports, we found that the self-control facet added to the predictive value for risky health behaviors, and that the conventionality facet provided additional value for predicting preventative health behaviors.
CHAPTER 6

CONCLUSIONS

In a series of three studies, we aimed to address several methodological issues regarding the link between conscientiousness and health behaviors. Specifically, we sought to address whether assessing lower-order facets provided additional value when predicting health behavior. Second, we investigated whether lower-order scales held their apparent validity even when holding overall conscientiousness constant. Third, we replicated this approach using observer ratings of personality rather than self-report. Overall, our results were much less supportive of the widely held assumption that lower-order approaches to measurement are always better. Rather, in very specific cases we found improved validity, but the increased validity was not as widespread, or apparent, as prior research would lead one to believe.

Our first effort focused on the putative advantages gained by using an empirically validated lower-order structure of conscientiousness to predict risky and preventative health behaviors. No study to date has used a measure or measures designed explicitly to assess the lower-order structure of conscientiousness. The prior meta-analytic work (Bogg & Roberts, 2004) categorized pre-existing scales into the facet domains of conscientiousness, but these measures were clearly only moderately related to their conceptual categories. The results across seven studies were similar to, but distinct from the prior meta-analytic work. Specifically, the conventionality and self-control domains were, once again, the best predictors of health behaviors, at least in magnitude and consistency. However, industriousness, which previously showed a more heterogeneous profile of correlations, was much more strongly and systematically linked to health behaviors.
Probably most inconsistent with prior research was the fact that overall conscientiousness was just as strongly correlated with health behaviors as any of the specific facets. This finding goes to support a perspective counter to the accepted wisdom that narrower is always better (e.g., Paunonen & Ashton, 2001). Rather, what this pattern implies is that if the global measure includes all of the facets, then the global measure might do just as well, if not better than lower-order scales (see Ones & Viswesvaran, 1996). Obviously, this pattern is driven in part by the nature of the health behavior measure. It is possible that the Health Behavior Checklist is broad and inclusive and therefore best predicted by a broad and inclusive measure. Nonetheless, the finding that overall conscientiousness works so well, invites the question of whether and how the lower-order facets might do better. This question was addressed in our second set of analyses in which we systematically pitted the facets against the overall conscientiousness dimension.

Using a bi-factor model, we partitioned conscientiousness into the higher-order trait and its lower-order constituent facets, and examined the incremental predictive value of assessing facets. As noted in the meta-analysis of our seven data sets, the zero-order correlations suggested that self-control, industriousness, and conventionality were the most important facets of conscientiousness for predicting health behaviors. The bi-factor models confirmed the importance of the self-control and conventionality facets of conscientiousness. Both of these facets predicted risky health behaviors above and beyond the latent dimension of conscientiousness in the self-report studies. This finding provides the most rigorous way to test the idea that lower-order facets improve on the validity of general scales. Finally, in Study 3, we demonstrated again the utility of assessing self-control, in that this facet continued to add to the prediction of health behavior even when using observer reports. Conventionality also provided incremental validity, but in this case to preventative health behaviors, not risky health behaviors.
as found with self-reports. Therefore, across 4 different samples and two methods, self-control was the only facet to reliably and consistently predict health behavior above and beyond overall conscientiousness.

Although previous research has suggested the additional utility of examining lower-order traits (e.g., Paunonen & Ashton, 2001), the current work is among the first studies to systematically address the importance of employing facet measures relative to broader, domain measures of personality traits. While our studies focus on a specific trait (conscientiousness) and a specific outcome (health behavior), our results add greatly to the discussion of lower-order versus broad measures. However, overall conscientiousness always proved a strong predictor of health behaviors, with zero-order associations at least as strong as the facet measures. Given that our work would suggest that facets vary in their utility, we encourage future personality research which continues to examine the relative predictive validity of facet measures using similar bi-factor techniques and a variety of outcomes.

Although several facets initially showed significant relationships with health behaviors in the opposite direction from expected, these seemingly anomalous results were mostly explained through the application of a secondary bi-factor analysis. By removing the direct path from overall conscientiousness to health behavior, the counterintuitive findings were generally removed. These results suggest that the initially anomalous findings likely resulted because overall conscientiousness was accounting for most of the predictable variance in health behavior. In future research with bi-factor models, researchers should consider using similar techniques to help explain any counterintuitive results.

Although our studies benefit from the use of multiple samples, meta-analytic synthesis, multiple methods, and the use of samples across different countries, a few limitations to the
current work still remain that should serve to direct future research. For one, the health behavior measures in our studies demonstrated less than ideal reliabilities in some cases. In addition, it would be valuable to examine these effects with more objective markers of health behavior. For instance, do the facets of conscientiousness add to the prediction of medical adherence, as reported on by doctors or even on-line measures of physical activity? Alternatively, it would be beneficial to employ close associate reports of a target’s healthy (or unhealthy) activities. Moreover, future work needs to be done to expand and refine facet measures of conscientiousness (e.g., Jackson et al., 2008).

Across our studies, we illustrate that the self-control and conventionality facets are most strongly related to health behaviors and would most profitably be included in future research. This series of studies found evidence for both the importance of studying the lower order facets of conscientiousness, as well as replicating previous findings regarding the usefulness of assessing overall conscientiousness when studying health and health behaviors. Such findings further our understanding both of whether it is valuable to assess lower-order traits, rather than just broader domains, as well as provide insights for health care professionals. For instance, doctors should anticipate that patients higher in self-control will live healthier lives, and thus, assessing patients’ dispositional self-control can help inform individualized policies and practices. In this respect, studies similar to the current ones can further our understanding both of personality assessment methods, as well as of the important outcomes readily predicted by personality traits.
REFERENCES


Table 1
Meta-Analytic Estimates of the Correlations Between Facets of Conscientiousness, HBC Subscales, and Composites for Risky and Preventative Health Behaviors

<table>
<thead>
<tr>
<th>Facet</th>
<th>Rho</th>
<th>CI LOW</th>
<th>CI HIGH</th>
<th>Q</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Self-Control</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>0.08</td>
<td>0.18</td>
<td>15.1</td>
</tr>
<tr>
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<td>-0.12</td>
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</tr>
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<td>-0.25</td>
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</tr>
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</tr>
<tr>
<td>Wellness Maintenance</td>
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<td>0.04</td>
<td>0.16</td>
<td>19.9</td>
</tr>
<tr>
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<td>-0.13</td>
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<td>-0.04</td>
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<td>0.1</td>
<td>0.23</td>
<td>18.4</td>
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</tbody>
</table>
Note. The total number of studies (K) for all analyses was seven. Number of participants varies by study. Random model values reported. “RISKY” and “PREVENTATIVE” composite variables are in all caps to indicate composite nature as distinct from the other single factor health behavior scales reported.
* Denotes significant relationship based on 95% confidence interval.
Table 2
Meta-Analytic Estimates of Correlations between Overall Conscientiousness, Overall Risky and Preventative Health Behaviors, and Health Behavior Subscales

<table>
<thead>
<tr>
<th>Health Behavior</th>
<th>Total Sample N</th>
<th>K</th>
<th>Rho</th>
<th>95% CI Low</th>
<th>95% CI High</th>
<th>Q</th>
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Note. K = total number of studies in each analysis. Random model values reported. “RISKY” and “PREVENTATIVE” composite variables are in all caps to indicate composite nature as distinct from the other single factor health behavior scales reported.

* Denotes significant relationship based on 95% confidence interval.
### Table 3
*Study 2 Bi-Factor Model Results.*

<table>
<thead>
<tr>
<th>Sample 1</th>
<th>Risky Health Behaviors</th>
<th>Preventative Health Behaviors</th>
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<tbody>
<tr>
<td>Overall</td>
<td>r</td>
<td>SEM β</td>
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<tr>
<td>Conscientiousness</td>
<td></td>
<td></td>
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<tr>
<td>Self-control</td>
<td>-.36*</td>
<td>-.48*</td>
</tr>
<tr>
<td>Industriousness</td>
<td>-.14*</td>
<td>.30*†</td>
</tr>
<tr>
<td>Orderliness</td>
<td>-.10*</td>
<td>.06*†</td>
</tr>
<tr>
<td>Reliability</td>
<td>-.20*</td>
<td>.06</td>
</tr>
<tr>
<td>Conventionality</td>
<td>-.31*</td>
<td>-.36*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample 6</th>
<th>Risky Health Behaviors</th>
<th>Preventative Health Behaviors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>r</td>
<td>SEM β</td>
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<tr>
<td>Conscientiousness</td>
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<td>Self-control</td>
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<td>-.77*</td>
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<td>Industriousness</td>
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<td>Orderliness</td>
<td>-.21*</td>
<td>-.09</td>
</tr>
<tr>
<td>Reliability</td>
<td>-.35*</td>
<td>---</td>
</tr>
<tr>
<td>Conventionality</td>
<td>-.49*</td>
<td>-.30*</td>
</tr>
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<table>
<thead>
<tr>
<th>Sample 7</th>
<th>Risky Health Behaviors</th>
<th>Preventative Health Behaviors</th>
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<tbody>
<tr>
<td>Overall</td>
<td>r</td>
<td>SEM β</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-control</td>
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<td>-.43*</td>
</tr>
<tr>
<td>Industriousness</td>
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<td>-.44*</td>
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<tr>
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<td>.19</td>
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<tr>
<td>Reliability</td>
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<td>.44*†</td>
</tr>
<tr>
<td>Conventionality</td>
<td>-.08</td>
<td>.37*†</td>
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*Note.* Risky and preventative health behaviors modeled as latent variables. Variances set to be equal for residuals. Error terms correlated for parcels not being tested. Zero order correlations reported. Missing data indicates lack of model convergence due to negative variance estimation for one of the facet specific error terms. All fit indices reported are those of the default model. Fit indices for overall conscientiousness in Sample 7 most likely reflected a saturated model due to correlation of the parcel error terms.

† = significant correlation in counter-intuitive direction.
* p < .05.
## APPENDIX D

### Table 4

**Bi-Factor Model Results for Observer-Rated Conscientiousness.**

<table>
<thead>
<tr>
<th>Sample 2 Observer</th>
<th>Risky Health Behaviors</th>
<th></th>
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<th>Preventative Health Behaviors</th>
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<tbody>
<tr>
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<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Conscientiousness</td>
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<td>-.42*</td>
<td>.07</td>
<td>.93</td>
<td>.31*</td>
<td>.28*</td>
</tr>
<tr>
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<td>-.20*</td>
<td>.07</td>
<td>.92</td>
<td>.25*</td>
<td>.08</td>
</tr>
<tr>
<td>Industriousness</td>
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<td>.13</td>
<td>.07</td>
<td>.92</td>
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<td>.07</td>
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<td>.22*</td>
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<table>
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<td>.51*</td>
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<tr>
<td>Industriousness</td>
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<td>.08</td>
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<td>---</td>
<td>.10*</td>
<td>.06</td>
</tr>
</tbody>
</table>

**Note.** Risky and preventative health behaviors modeled as latent variables. Variances set to be equal for residuals. Error terms freely correlated and constrained to be equal for parcels not being tested. Zero order correlations reported. Missing data indicates lack of model convergence due to negative variance estimation for one of the facet specific error terms. All fit indices reported are those of the default model.

† = significant correlation in counter-intuitive direction.

* *p < .05.
**Fig.1.** General bi-factor model used in Study 2 and 3 to test the predictive validity of conscientiousness facets above and beyond the global trait of conscientiousness. Error terms freely correlated and constrained to be equal for parcels not being tested to reflect the implied facet level latent variables in the model and to improve model fit. In this example the predictive validity of the self-control facet is being tested in relation to risky health behavior.