

Do Conscientious Individuals Live Longer? A Quantitative Review

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Objective: Following up on growing evidence that higher levels of conscientiousness are associated with greater health protection, the authors conducted a meta-analysis of the association between conscientiousness-related traits and longevity. **Design:** Using a random-effects analysis model, the authors statistically combined 20 independent samples. In addition, the authors used fixed-effects analyses to examine specific facets of conscientiousness and study characteristics as potential moderators of this relationship. **Main Outcome Measures:** Effect sizes were computed for each individual sample as the correlation coefficient r , based on the relationship between conscientiousness and mortality risk (all-cause mortality risk, longevity, or length of survival). **Results:** Higher levels of conscientiousness were significantly and positively related to longevity ($r = .11$, 95% confidence interval = .05–.17). Associations were strongest for the achievement (persistent, industrious) and order (organized, disciplined) facets of conscientiousness. **Conclusion:** Results strongly support the importance of conscientiousness-related traits to health across the life span. Future research and interventions should consider how individual differences in conscientiousness may cause and be shaped by health-relevant biopsychosocial events across many years.

Keywords: personality traits, conscientiousness, longevity, mortality risk, meta-analysis

To what extent can personality predict important life outcomes, including longevity? This question is of increasing interest, for both practical and conceptual reasons. On the practical side, it is expensive to add even brief personality assessments to health screenings or large epidemiological studies of mental and physical health, but such assessments should be included if they demonstrate meaningful predictive value. On the conceptual side, the issue is relevant to how we think about individual differences and trajectories across the life span (Swann & Seyle, 2005). Growing evidence suggests that personality plays an important role in health-related processes, although its impact has been underacknowledged (Duberstein, Seidlitz, Lyness, & Conwell, 1999; Friedman, 2007; Ozer & Benet-Martínez, 2006).

A thorny problem, however, has been that many well-being outcomes are subjective and share method and definitional variance with measures of personality. For example, both personality and outcomes such as subjective well-being, health behaviors, and social relationships often depend on self-report measures. Furthermore, some relations are bidirectional, with outcomes also causing individual differences, as when health and social relationships alter personality (Friedman, 2007). Mortality is a valid and reliable

health outcome that is both objective and arguably the endpoint in a causal connection. Recent research, using modern concepts of personality, has demonstrated that aspects of personality are indeed associated with longevity (Danner, Snowdon, & Friesen, 2001; Friedman, 2007; Roberts, Kuncel, Shiner, Caspi, & Goldberg, 2007; Smith, 2006), but the cross-study strength and reliability of this relation remains unclear. If the combined effects of numerous studies demonstrate that personality is indeed predictive of mortality risk, fundamental implications are raised regarding individual differences in psychobiology, situational selection, and chronic patterns of health behaviors, decision making, and stable reaction patterns.

Conscientiousness

Studies linking personality with objective health outcomes, such as all-cause mortality and cardiovascular heart disease, have primarily focused on negative traits, such as depression, Type A behavior pattern, and hostility (Friedman & Booth-Kewley, 1987; Smith, 2006; Smith & Williams, 1992). Increasing attention is now being given to conscientiousness (e.g., Friedman et al., 1993; Hampson, Goldberg, Vogt, & Dubanoski, 2006; O’Cleirigh, Ironson, Weiss, & Costa, 2007); in the present study, we focused specifically on the association between conscientiousness and mortality risk.

Conscientiousness is a general personality factor subsuming multiple traits, including organization, thoroughness, reliability, competence, order, dutifulness, achievement striving, self-discipline, and deliberation (Costa & McCrae, 1998; Goldberg, 1993; Roberts, Walton, & Bogg, 2005), and it relates (inversely) to Eysenck’s psychoticism factor (Goldberg, 1993). One intriguing finding from a prospective life span study (Friedman et al., 1993) suggested that conscientiousness measured in childhood could

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predict longevity decades into the future. Following up with participants in the Terman Life Cycle Study, the study found that higher levels of conscientiousness, as rated by parents and teachers in 1922, were significantly related to longer life over a 7-decade period. This relation held across various causes of death (Friedman et al., 1995). This finding has led to several follow-up studies using diverse samples. In a recent synthesis, Roberts and colleagues (2007) examined findings from four studies (Christensen et al., 2002; Friedman et al., 1993; Weiss & Costa, 2005; Wilson, Mendes de Leon, Bienias, Evans, & Bennett, 2004) and, indeed, found a protective effect, similar in magnitude to the effect of intelligence on longevity. Research has also linked higher levels of conscientiousness to positive health behaviors (Bogg & Roberts, 2004) and improved life functioning (Soldz & Vaillant, 1999).

A closer look at the different facets that comprise conscientiousness may supplement our understanding of the processes involved in a conscientiousness–longevity link (Caspi, Roberts, & Shiner, 2005; Costa & McCrae, 1998; Roberts, Bogg, Walton, Chernyshenko, & Stark, 2004; Roberts, Chernyshenko, Stark, & Goldberg, 2005). For example, several sociological studies of long-lived individuals have suggested that particular conscientiousness-related attributes are evident in the oldest old and centenarians (e.g., Jewett, 1973; Samuelsson et al., 1997; Shimonaka, Nakazato, & Homma, 1996). Bogg and Roberts (2004) used meta-analytic techniques to evaluate the association between specific facets of conscientiousness and health-related behaviors and found that some facets were more strongly related to health behaviors than others. Specifically, responsibility, self-control, and traditionalism were important predictors across health behavioral domains, whereas links to health behaviors were less consistent for other lower order traits. A study of elderly individuals (Weiss & Costa, 2005) found that only the self-discipline facet was associated with longer life. In other studies, low levels of self-control, responsibility, and industriousness were individually associated with increased mortality risk (Fry & Debats, 2006), and impulsivity (low self-control) was related to increased suicidality (Brezo, Paris, & Turecki, 2006). In the present study, we examined three specific facets: responsibility/self-control (socially responsible, self-controlled, and not impulsive); order (organized, efficient, and disciplined); and achievement (achievement oriented, persistent, and industrious).

The Present Study: A Meta-Analytic Synthesis

Meta-analysis, or the quantitative synthesis of existing studies, offers an empirical method for combining the results of multiple studies to determine overall associations and for exploring possible moderators that may explain discrepant results across studies (Rosenthal, 1991; Rosenthal & DiMatteo, 2001). The present meta-analysis aimed to update and extend previous findings with a thorough search of the existing literature and the use of meta-analytic techniques to assess both the overall construct of conscientiousness and lower order traits. Furthermore, this approach allowed examination of plausible moderators of this relation.

First, we predicted that the higher order factor of conscientiousness would positively relate to longevity—that is, conscientious people were expected to live longer than those who were less conscientious. Second, we examined the three facets of conscien-

tiousness, and we hypothesized that the responsibility/self-control facet would be more relevant to longevity than the achievement and order facets, consistent with the Bogg and Roberts (2004) review on health behaviors. Third, we considered potential moderators—length of follow-up, the measure used to assess personality, the sample population, gender composition, and country of study—and examined whether these factors moderated the conscientiousness–longevity relationship. Finally, we considered the recency of research and predicted that there would be a difference between studies published before 1993, when the link between conscientiousness and longevity was first clearly identified (Friedman et al., 1993), and those published after, as better measures were used over time.

Method

Literature Search Procedure

Two different search strategies were used to locate potential studies for the present synthesis. First, a cited reference search was conducted on the Friedman et al. (1993) article. Promising titles and abstracts were examined for inclusion. Each identified study was then submitted to the PsycINFO and Web of Science online databases, and forward and backward search procedures were conducted. Specifically, reference sections were scanned for prior studies mentioning conscientiousness (or associated traits) and longevity (or mortality risk), and titles were submitted to a cited reference search to locate more recent studies. Pertinent studies were located and retained if they met the inclusion criteria (see below).

Second, we performed a series of keyword searches using the following online databases: PsycINFO, Web of Science, Medline, PubMed, and Google Scholar. The search was limited to published studies written in English with human participants. First, *conscientiousness* was combined with *mortality* OR *longevity* OR *long life*. Second, we searched for specific characteristics and scales that describe conscientiousness, following the comprehensive search procedures detailed by Bogg and Roberts (2004).¹

¹ Search terms included *achievement, achievement striving, avoids trouble, cautious, competence, conformity, constraint, conventional, decisive, deliberate, disinhibition, disorderly, dutiful, efficient, endurance, formal, good impression, impulsive, impulse control, industrial, inhibited, labile, moralistic, orderly, organized, perfectionistic, prudent, psychoticism, punctual, purposeful, rational, regimented, reliable, responsible, rule conscientiousness, self-control, self-discipline, self-regulation, social conformity, socialization, spontaneous, traditional, uninhibited, and virtue* (and several variants of these terms). In addition, we searched for specific scales that include aspects of conscientiousness: 16 Personality Factor Questionnaire, Adjective Checklist, Barratt Impulsivity Scale, Bentler Psychological Inventory, California Psychological Inventory, Californai Q-set, Eysenck Personality Questionnaire, Hogan Personality Inventory, Jackson Personality Inventory, Karolinska Scale of Personality, Minnesota Multiphasic Personality Inventory, Multidimensional Personality Questionnaire, NEO Five Factor Inventory, Personality Research Form, Rosenbaum Self-Control Questionnaire, Schaling Impulsivity Scale, Sensation Seeking Scale, and the Tridimensional Personality Questionnaire.

Inclusion and Exclusion Criteria

Studies were included in the meta-analysis only if they met several criteria. A study had to (a) be an empirical study published in a book or journal before July 1, 2006; (b) include an identifiable measure of a conscientiousness-related trait; (c) assess all-cause mortality (or longevity) as a primary outcome; and (d) provide sufficient information to compute an effect size (either exact or estimated). To avoid a bias that has plagued this research field (i.e., the likelihood of ignored comorbidity), we only included studies with all-cause mortality as an outcome. Among identified studies ($N = 56$), 11 were excluded from the main analysis because the outcome was not specifically mortality or because it focused solely on a specific cause of death (i.e., suicidality or death from cancer rather than all-cause mortality); a supplemental analysis was performed on these studies. Of the remaining 45 studies, 26 were excluded because they failed to meet one of the other inclusion criteria, leaving a final set of 19 studies.

Coding and Moderators

For each study, the following were recorded: number of participants, facet of conscientiousness assessed (achievement, order, or responsibility/self-control), year of study (pre-1993 and later), measure used (Minnesota Multiphasic Personality Disorder [MMPI], NEO Five-Factor Inventory, or other), type of sample (community-dwelling or patient population), length of follow-up (5 years or less or more than 5 years), country of study, gender composition (percentage female), and the average effect size. Each independent sample was coded separately. We focused on the overall effect of conscientiousness and three specific facets: (a) achievement orientation, measured by the Cesarec-Marke Personality Schedule "need for achievement" (Cesarec & Marke, 1968) scale, the Personality Research Form "achievement-oriented/disciplined" (Stumpf, Angleitner, Wieck, Jackson, & Beloch-Till, 1985), and indicators of achievement motivation based on self-reported questions; (b) need for order, measured by the Cesarec-Marke Personality Schedule "need for order" scale and the NEO Five Factor Inventory Conscientiousness scale (Costa & McCrae, 1992); and (c) social responsibility/self-control, measured by the Eysenck Personality Questionnaire Psychoticism scale (Eysenck & Eysenck, 1975; Hosokawa & Ohyama, 1993), the MMPI Psychopathic Deviate scale (Hathaway & Briggs, 1940), the Terman Life Cycle Study Conscientiousness scale (Friedman et al., 1993), and indicators of impulsivity, poor impulse control, risk-taking orientation, and social responsibility.

Statistical Analyses

Effect sizes were computed for each individual sample in the form of the correlation coefficient, r (as Pearson product-moment correlations, point biserial correlations, or phi coefficients, depending on the characteristics of variable measurement). If coefficient values were not directly reported, r -equivalent values were calculated following formulas provided by Rosenthal (1991, 1994) and Rosenthal and DiMatteo

(2001), using either exact p values or conservative p -value cutoffs. For example, studies that used survival analyses typically reported a p value for the conscientiousness-longevity relationship; we converted this to an r -equivalent value. If exact p values were not reported, the following one-tailed Z s were used: $p < .05$, $Z = 1.645$; $p < .01$, $Z = 2.326$; and $p < .001$, $Z = 3.090$. Nonsignificant results with no additional data were recorded as $p = .50$, $Z = 0.00$. These values represent the most conservative estimates of reported results and most likely underestimate actual effects.

To investigate the overall association between conscientiousness and longevity and to explore possible moderators, calculations were performed using Fisher's Z -to- r transformation of the effect sizes, and the resulting values were transformed back to r for presentation purposes. Two studies (Nilsson & Persson, 1984; Persson, 1981) reported multiple facets of conscientiousness; for these studies, effect sizes were calculated separately for each facet and then aggregated to derive a single effect for the main analysis (Rosenthal, 1991). Overall weighted and unweighted means, medians, and 95% confidence intervals (CIs) were calculated following a random-effects approach. Random-effects analyses are more stringent and robust than fixed-effects analyses and have the advantage that results can be generalized beyond the studies sampled (Raudenbush, 1994).

Because of the relatively small number of studies included, moderators were examined using the less stringent and less generalizable fixed-effects model. This approach offers a more powerful analysis, with smaller confidence intervals and greater opportunity for significance, but with more limited generalizability of results to only the sample populations included in the analysis (Hedges, 1992, 1994). Variability among effect sizes was examined using contrast t tests, following our hypotheses. Means, medians, and standard deviations were calculated using SPSS 11.5; all other meta-analytic calculations including moderator components were calculated using a four-function calculator to foster intimacy with the data (Rosenthal, 1995).

To address the possibility of publication bias of significant effects (i.e., the file-drawer problem; Rosenthal, 1991), the fail safe N (FSN) and tolerance levels were calculated. The FSN indicates how many unpublished studies with an average of zero effect would be needed for a significant result to be reduced to nonsignificance, and the tolerance level provides a conservative cutoff value for comparison (more than five times the number of studies included in the review; see Rosenthal, 1991). If the FSN exceeds the tolerance level, then the effect is resistant to the file-drawer threat.

Results

From the 19 studies meeting the inclusion criteria, 20 independent samples were coded and 8,942 participants were included. Studies were completed in six different countries: the United States, Canada, Germany, Norway, Japan, and Sweden. Table 1

Table 1
Study Information

Study	Sample	Conscientiousness scale	Construct measured	Effect size (<i>r</i>)
Bartle & Bishop (1974)	40 coronary heart disease patients with unexpectedly long survival	MMPI	Psychopathic Deviate	.38
	74 angina pectoris patients with unexpectedly long survival	MMPI	Psychopathic Deviate	.14
Brown, Nesse, Vinokur, & Smith (2003)	1,532 individuals from the Changing Lives of Older Couples Study	NEO Five Factor Personality Inventory	Conscientiousness	.05
Canada, Fawzy, & Fawzy (2005)	60 patients with Stage 1 malignant melanoma	Eysenck Personality Questionnaire	Psychoticism	.03
Christensen et al. (2002)	174 patients with chronic renal insufficiency	NEO Five Factor Personality Inventory	Conscientiousness	.17
Fichter, Quadflieg, & Hedlund (2006)	103 anorexic patients treated in a hospital in Upper Bavaria, Germany	Psychologists ratings	Impulsivity	.00
Friedman et al. (1995)	1,215 members of the Terman Life Cycle Study	Childhood ratings by teachers and parents	Conscientiousness	.09
Fry & Debats (2006)	380 older community members from southern Alberta, Canada	Self-ratings on a series of questions	Social responsibility	.08
Gillum, Leon, Kamp, & Becerra-Aldama (1980)	281 healthy middle-aged men from the Cardiovascular Disease Project	MMPI	Psychopathic Deviate	.00
Kjelsberg, Sandvik, & Dahl (1999)	1,095 former adolescent psychiatric patients in Oslo, Norway	Ratings from hospital records	Poor impulse control	.09
Matter (1979)	108 graduates from a small Kansas high school	Autobiographical accounts	Achievement motivation	.27
McCann (2005)	32 U.S. presidents from Washington to Nixon	Estimate of Big Five traits	Conscientiousness	.41
Nakaya, Tsubono, Nishino, et al. (2005)	819 residents in Miyagi, Japan, with cancer	Eysenck Personality Questionnaire short form revised, Japanese version	Psychoticism	.02
Neuser (1988)	35 patients with acute leukemia, treated at the West German Tumor Center Essen	Personality Research Form, German version	Achievement oriented/disciplined	.13
Nilsson & Persson (1984)	295 older adults in Gothenburg, Sweden	Cesarek Marke Personality Schedule	Need for achievement, need for order	.01
Persson (1981)	392 older adults in Gothenburg, Sweden	Cesarek Marke Personality Schedule	Need for achievement, need for order	.00
Reynolds & Nelson (1981)	193 institutionalized elderly chronically ill patients in Los Angeles Veterans Affairs nursing home	Self-report psychological scales	Orientation toward risk taking	.05
Weiss & Costa (2005)	1,076 members of the Medicare Demonstration study	NEO Five Factor Personality Inventory	Conscientiousness	.07
Wilson, Mendes de Leon, Bienias, Evans, & Bennett (2004)	883 members of the Religious Orders Study	NEO Five Factor Personality Inventory	Conscientiousness	.14
Yen & Siegler (2003)	155 graduates from a large state university	MMPI	Psychopathic Deviate	.07

Note. Variables were coded such that high conscientiousness is positively related to longevity. High impulsivity was coded as low conscientiousness (i.e., a positive correlation for impulsivity indicates that lower levels of impulsivity were associated with longevity). Studies that provided multiple effect sizes were aggregated to provide a single effect size for the overall analysis. MMPI = Minnesota Multiphasic Personality Inventory.

summarizes these studies, including the total number of participants, the measure of conscientiousness used, and the overall effect size. For clarity, the effects were coded to reflect the hypothesis that higher levels of conscientiousness are positively related to longer life (and negatively related to mortality risk).

Thus, a positive *r* effect size reflects the association of higher conscientiousness with greater longevity. No negative (inverse) associations were found.

Table 2 summarizes the results of the overall analysis and the moderator analyses. Conscientiousness was significantly associ-

Table 2
Summary of the Overall Association Between Conscientiousness and Longevity and Moderator Analyses

Variable	<i>k</i> (no. studies)	<i>Mdn</i> (range)	Weighted <i>M</i> ^a	Unweighted <i>M</i> (95% confidence interval) ^b	Relative risk (risk difference; %)	Odds ratio	Test for moderation ^c
Combined overall effect	20	.08 (.00-.41)	.07	.11 (.05-.17) ^{***}	.80 (11.25)	.64	—
Facet of conscientiousness							
Achievement/order	9	.13 (.00-.41)	.08	.14 (.04-.24) [*]	.75 (14.11)	.57	<i>t</i> (8940) = -3.75 ^{***}
Responsibility/control	11	.07 (.00-.38)	.07	.09 (.01-.16) [*]	.84 (8.86)	.70	<i>r</i> = -.04
Year of study							
Pre-1993	8	.09 (.00-.38)	.05	.12 (.00-.24) [*]	.78 (12.48)	.61	<i>t</i> (8940) = 7.28 ^{***}
Post-1993	12	.08 (.00-.41)	.08	.10 (.03-.17) ^{**}	.81 (10.36)	.66	<i>r</i> = .08
Measure used							
MMPI	4	.11 (.00-.38)	.07	.15 (-.12-.41)	—	—	<i>t</i> _{contrast} (8939) = 4.92 ^{***}
NEO	5	.13 (.00-.41)	.09	.17 (-.02-.35)	—	—	<i>r</i> = .05
Other scales	11	.05 (.00-.26)	.07	.07 (.02-.12) [*]	.87 (6.99)	.76	
Subject characteristics							
Normal adults	12	.07 (.00-.41)	.07	.10 (.02-.18) [*]	.81 (10.36)	.66	<i>t</i> (8940) = 8.69 ^{***}
Patients	8	.11 (.00-.38)	.10	.13 (.02-.23) [*]	.78 (12.53)	.60	<i>r</i> = .09
Length of follow-up							
≤5 years	10	.13 (.00-.41)	.08	.16 (.05-.26) ^{**}	.73 (15.67)	.53	<i>t</i> (8940) = 5.54 ^{***}
5 years	10	.05 (.00-.26)	.07	.07 (.01-.12) [*]	.88 (6.66)	.77	<i>r</i> = .06

Note. Positive values indicate a positive relation between higher conscientiousness and longevity. MMPI = Minnesota Multiphasic Personality Inventory; NEO = NEO Five-Factor Inventory.

^a Weighted by degrees of freedom (*N* - 3), based on total number of participants (8,942). ^b Mean unweighted effect size and the 95% confidence interval, based on a random-effects model. ^c Significance tests are based on a fixed-effects analysis, comparing weighted mean values. For measure used, the contrast tested the hypothesis that the NEO would be higher than the MMPI and other measures ($\lambda = -1, 2, -1$).

* *p* < .05. ** *p* < .01. *** *p* < .001.

ated with longevity in the robust and generalizable random-effects model (*r* = .11, 95% CI = .05-.17).² The FSN was calculated to be 322, with a tolerance level of 110, suggesting that the results are robust and unlikely to be altered by unpublished studies.

A test of homogeneity was significant, $\chi^2(19) = 39.66, p = .0036$, suggesting that although the effect sizes are generally positive, there is some variation that may be explainable by moderating factors.³ The effect was slightly stronger for studies using the NEO Five Factor Inventory to measure conscientiousness, compared with the MMPI and other measures, *t*(8939) = 4.92, *r* = .05. Effect sizes were stronger for patient populations, *t*(8940) = 8.69, *r* = .09, and for shorter follow-up intervals, *t*(8940) = 5.54, *r* = .06. Only two studies reported effect sizes for the achievement facet. Because we predicted that the responsibility facet would be most relevant to survival, we combined the achievement and order facets and compared these to the responsibility/self-control facet. Contrary to our hypothesis, responsibility was less strongly related to longevity than achievement/order, *t*(8940) = -3.75, *r* = -.04. Country of study and gender composition did not significantly moderate the relation between conscientiousness and longevity.⁴

The original study linking conscientiousness and longevity (Friedman et al., 1993) included 1,178 participants and had an estimated effect of *r* = .09.⁵ Studies conducted after 1993 (using more modern, reliable measures) found a similar effect, *r*(7486) = .08 (95% CI = .06-.10; weighted fixed-effects analysis), supporting both the direction and the magnitude of the original finding. Studies conducted before 1993 (which typically used smaller sample sizes and focused on traits composing conscientiousness rather than conscientiousness per se) demonstrated a weaker yet still significant effect, *r*(1,394) = .05 (95% CI = .00-.10).

In the main analysis, we included only studies with all-cause mortality as the outcome. We conducted a supplemental analysis on 11 studies that considered death from a specific cause of death (thus excluding people who may have died from other causes). One study included two independent samples; thus, the supple-

² This is the unweighted average effect size. Some computer programs will compute the average effect weighted by the degrees of freedom (*r* = .07, 95% CI = .05-.09), as reported in the Weighted means column in Table 2. The severity of problems caused by hugely disparate sample sizes is minimized when the minimal sample size is greater than 20, as it is in this analysis, so an unweighted effect size is appropriate in the random-effects analysis (R. Rosenthal, personal communication, September 11, 2007). In addition, for the three studies that reported a nonsignificant *r* effect size, we used *r* = 0 as a conservative estimate. Some analysts suggest not including studies when the exact effect size cannot be included. Excluding these studies produced a larger overall effect: unweighted *r* = .13 (95% CI = .07-.19); weighted *r* = .08 (95% CI = .06-.10).

³ The chi-square is a fixed-effects test; significance is affected by the number of participants, not by the number of studies. Regardless of whether the chi-square test is significant, moderators should be analyzed, as moderators help explain variation that we see and can enhance our theoretical understanding of processes involved (Rosenthal & DiMatteo, 2001).

⁴ After this article was in production for publication, we discovered a recent finding from a 7-year study in Scotland (Whiteman, 2006), which reported that conscientious men were 30% less likely to die from any cause, a result fully consistent with our meta-analytic findings.

⁵ We used the Friedman et al. (1995) follow-up study in the meta-analysis, as it used the same sample, was of equal effect size, and focused more specifically on the effect of conscientiousness than on personality in general.

mental analysis included 12 samples and 37,996 participants. Cause of death outcomes were suicide, myocardial infarction, and cancer. The overall average effect was positive but nonsignificant ($r = .05$, 95% CI = $-.03-.13$), although there was substantial heterogeneity across studies, $\chi^2(11) = 427.21$, $p < .001$. In particular, effect sizes depended on the facet assessed (stronger effects for achievement/order than for responsibility/control), the measure used (stronger effects if the NEO was used than if the MMPI or other scales were used), the population (stronger effects for patient populations than for community-dwelling populations), and length of follow-up (stronger effects for shorter follow-up intervals).

Discussion

Pooling the results of 20 independent samples, we found an overall average r effect of .11 between conscientiousness and longevity. That is, individuals higher on conscientiousness were less likely to die at any given age than those lower on conscientiousness. This positive relation confirms and extends the association first presented by Friedman and colleagues in 1993.

Notably, this association included more than 8,900 diverse participants, represented individuals from multiple countries, and is comparable in size to other important epidemiological effects. In the health field, practical significance is often much larger than effect sizes first suggest. For example, some of the most important effects in medicine, such as the effect of aspirin on reducing heart disease or the effect of the Salk vaccine on paralytic poliomyelitis, may be considered small (average r s between .01 and .04; Rosenthal & Rosnow, 2008; Rosenthal & DiMatteo, 1991), yet are important when the number of lives saved is taken into account (Rosenthal, 1994). (See Rosenthal & Rosnow, 2008, and Meyer et al., 2001, for additional examples of important comparable effect sizes in both medical and psychological research.) Furthermore, this effect is greater than the effect of intelligence on mortality risk ($r = .07$; Roberts et al., 2007).

What does this say about personality, particularly conscientiousness? On the practical side, personality is indeed an important, health-relevant component of personhood, and treatment decisions and long-term interventions should consider how personality may contribute to (or detract from) health. On the conceptual side, it appears important to understand how individual differences, especially involving conscientiousness, cause and are shaped by trajectories and events across the life span (Friedman, 2000). Finally, because death is a valid and reliable health outcome, sharing neither definitional nor assessment variance with personality, questions about the utility of personality constructs within a health context should be put to rest.

There are multiple pathways through which conscientiousness may influence life and death outcomes. Conscientiousness has already been linked to health behaviors (Bogg & Roberts, 2004); a next step requires examining the degree to which health behaviors may mediate the pathway between conscientiousness and longevity. There is some indication that when health behaviors are controlled, conscientiousness still predicts longer life, although the effect is partially attenuated (Friedman et al., 1995; Martin, Friedman, & Schwartz, 2007; Weiss & Costa, 2005; Wilson et al., 2004). Other mechanisms should also be appraised; for example, a biological pathway would suggest that underlying genetic or neurophysiological differences may make certain individuals more

conscientious and also promote longer life (Figueredo et al., 2005; Williams et al., 2004). Future studies should consider both psychosocial and biological mechanisms linking conscientiousness and longevity, as well as their interactions (Carver & Miller, 2006; Friedman, 2007; O'Cleirigh et al., 2007; Roberts et al., 2007; Smith, 2006).

In their meta-analysis on conscientiousness and health behaviors, Bogg and Roberts (2004) found that responsibility, self-control, and traditionalism were the strongest facet predictors across health behavioral domains, whereas order and industriousness were less consistent predictors. In our meta-analysis, however, responsibility was a weaker predictor of longevity. Responsibility and self-control may be more relevant to health behaviors, whereas other facets may be more relevant to length of life. Conversely, it remains unclear how lower order facets should be defined (Roberts, Chernyshenko et al., 2004, 2005), and the studies included in our analysis were not specifically focused on a facet-level analysis. Future research would benefit from considering the pathways involved not only for the overall construct of conscientiousness, but also with specific, lower order traits.

As a synthesis of existing studies, meta-analysis has both limitations and strengths. Any synthesis is only as good as the studies being combined. Some studies involved limited patient populations, did not directly measure conscientiousness, and varied in design. However, despite heterogeneity across studies in the definitions of conscientiousness, the measures used, the study design, and the populations assessed, average associations with longevity remained significant and positive. Furthermore, there is independent evidence from a nationally representative sample that conscientiousness is associated with good health (Goodwin & Friedman, 2006).

We included only published studies because given the difficulty, expense, and time needed to adequately examine longevity outcomes, it is unlikely that there are unpublished studies with the necessary analyses. As a safeguard, analyses suggested that effects were resistant to the file-drawer threat. A strength of our study is that we used a comprehensive search strategy, based on well-established work (Bogg & Roberts, 2004; Roberts et al., 2004), to identify studies on both the overall conscientiousness factor and specific facets. As conscientiousness was added to the factor model of personality later than other factors (Costa & McCrae, 1998; Goldberg, 1993), a look at related facets and traits reveals its enduring significance over time.

The present meta-analysis suggests important longevity-relevant associations of characteristics associated with the general conscientiousness factor. This is especially remarkable considering longevity is a multiply determined outcome. Significant attention should be directed to the role played by personality, especially conscientiousness, in important health-relevant processes.

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