

# Personality and Health, Subjective Well-Being, and Longevity

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**ABSTRACT** Personality traits can be employed to guide understanding of trajectories to health and longevity, but long-term longitudinal study and multifaceted assessment of healthy aging are crucial. Following up on the life span study initiated by Lewis Terman, we assessed 4 validated factors of personality in young adulthood in 1940, constructed a multifactor measure of participants' healthy aging in 1986, and collected death certificates through 2007 (to determine longevity) on a sample of 1,312 Terman participants (732 men). Neuroticism predicted worse physical health and subjective well-being in old age and, for women, higher mortality risk, but for men, neuroticism predicted decreased mortality risk. For both sexes, extraversion predicted old-age social competence, whereas conscientiousness predicted men's old-age productivity. Differential patterns of association between personality traits and healthy aging components are informative about individual personality characteristics and long-term health outcomes.

There seems little doubt that good mental health is generally associated with good physical health and that neurotic patterns like chronic anxiety and depression are associated with various health

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problems. Yet there is a surprising research nonchalance about what is meant by good health. This imprecision is compounded by an overreliance on cross-sectional or short-term studies with a restricted range of health outcomes. Indeed, although the fascinating associations between personality and health have inspired countless theories and studies (Friedman, 2007; T. W. Smith & Gallo, 2001), scientific progress will be hindered until we move beyond concurrent research designs, imprecise or idiosyncratic predictors, and vague definitions and measures of health.

Because personality encapsulates biological, experiential, and patterned social aspects of the individual, it can be a powerful summary construct for understanding and predicting important practical outcomes like health and success (Caspi, Roberts, & Shiner, 2005; Ozer & Benet-Martinez, 2006). Yet “health” is variously taken to refer to an assortment of subjective and objective states, ranging from a self-reported sense of well-being to risk of death. Although an array of health outcomes can be meaningful, they should not be used interchangeably. Feeling tired is not the same as being unable to work or being dead.

Because information on health outcomes that involve important matters such as longevity, serious disease, or productivity can be difficult to gather and because the optimal research designs often involve long-term, longitudinal study, psychological research commonly relies solely on subjective health and well-being. Self-reported health and subjective well-being are sometimes found to be predictive of disease and longevity (DeSalvo, Bloser, Reynolds, He, & Muntner, 2006; Idler & Kasl, 1991; Lyubomirsky, King, & Diener, 2005), but self-reporting that one is in poor health does not indicate which of the myriad possible conditions, judgments, and behaviors are playing a central or causal role. Further, although optimism and sense of well-being can predict better likelihood of recovery for those facing disease or surgery (Carver et al., 2005; Scheier et al., 1999), such matters may have limited longer-term relevance for those not facing acute challenge. Thus, it does not follow that research on individual differences and health should take the easy road, measure simple self-reported health or well-being as the outcome, and improperly assert that more general aspects of health are being validly measured. A range of outcomes is needed.

In particular, it is sometimes tempting to claim that optimism, agreeableness, and emotional stability/lack of neuroticism *cause*

good health, despite the mixed and limited nature of the empirical evidence. Many inconsistencies and paradoxes remain unexplained (Martin et al., 2002; Pressman & Cohen, 2005; Weiss & Costa, 2005). Self-reported optimism and good cheer share both method and conceptual variance with general self-reported health. Relevant personality scales include items that assess thoughts such as expectations that good things will happen, that one is warm and uncritical, and that one is not easily upset. Subjective health scales may likewise ask about the individual's feelings and mood, their (self-perceived) symptoms and complaints, and their experiences of well-being. Although not unimportant, such well-being questions are quite different from evaluating whether a person has developed a serious disease like cancer or heart disease, or whether a person has quality-impaired life activities due to limited mobility and inability to work, or whether one is at increased mortality risk. Such problems are especially common when one is using a convenience sample of college students, who vary relatively little in their health statuses. Even on broader biopsychosocial grounds, there is reason to question the assertion that chronic positive feelings directly cause better health. Studies of positive affect, optimism, low neuroticism, and health show a very wide range of hard-to-reconcile findings as a function of samples, measures, designs, and outcomes (Achat, Kawachi, Spiro, DeMolles, & Sparrow, 2000; Ferraro & Nuriddin, 2006; Friedman, 2008; Gardner & Oswald, 2004; Held, 2004; Howell, Kern, & Lyubomirsky, 2007; Korten et al., 1999; Wilson et al., 2005).

### Defining Healthy Aging

As fast-growing proportions of the populations of industrialized countries are reaching later-life years, there is increasing concern about not only attaining old age (longevity) but also living a healthy, connected, and productive life, that is, aging in a healthy manner. Aging well has been conceptualized in numerous ways, including variations in the theoretical orientation and the terminology used (Baltes & Baltes, 1990; Bryant, Corbett, & Kutner, 2001; Grzywacz & Keyes, 2004; Jeste, 2005; La Croix, Newton, Leveille, & Wallace, 1997; Morrow-Howell, Hinterlong, & Sherraden, 2001; Reed et al., 1998; Vaillant, 2002). In this project, we use the term *healthy aging*. In correspondence with the definition of *health* used by the World Health Organization (1946), we see healthy aging as

involving not only physical health but also psychological, social, cognitive, and functional components.

Aging has often been conceptualized as a progressive pathological breakdown of normal health functioning until death (Siegler, Bosworth, & Elias, 2003) and the individual's accepting and adapting to this natural decline as constituting successful old age (Aguerre & Bouffard, 2003; Anantharaman, 1979; Chapman, 2005; Havighurst, 1961). However, Rowe and Kahn (1987), noting that much heterogeneity exists, defined *successful aging* as a lack of significant physical disease and disability, high cognitive functioning, and remaining a productive member of society. Critics of this definition responded that requiring an absence of disease and disability is too exclusive; much of the older population has some sort of chronic disease or disability yet continues to thrive (Holstein & Minkler, 2003; Masoro, 2001; Minkler & Fadem, 2002; Scheidt, Humpherys, & Yorgason, 1999; Strawbridge, Wallhagen, & Cohen, 2002). For example, one study compared self-rated success with the Rowe and Kahn definition and found that over half of the participants said they were aging successfully, whereas only 19% were successful according to the Rowe and Kahn definition (Strawbridge et al., 2002). Similarly, a study in the Netherlands found only 10% fit Rowe and Kahn's definition, but almost half of the participants scored high on subjective well-being (von Faber et al., 2001). Furthermore, some individuals who fit successful aging criteria simply die suddenly at a younger age (Masoro, 2001), unintentionally suggesting an odd view whereby it is healthier to die.

Epidemiological studies (and cross-national comparisons) typically use longevity as a key marker of success. That is, healthy aging means optimizing life expectancy while reducing physical, psychological, and social morbidity problems (Fries, 1990), in essence, compressing morbidity into the last few years of a long life. However, such a focus on disease and longevity ignores the subjective and productive side (Krahn et al., 1994; Mroczek & Kolarz, 1998; Rudinger & Thomae, 1990). Kaplan (1994, 2003), therefore, has suggested an outcome-focused approach that incorporates not only morbidity and mortality but also health-related quality of life. Similarly, Baltes and Baltes (1990) proposed a multicomponent model that involves length of life, biological health, mental health, cognitive efficacy, social competence, productivity, personal control, and life satisfaction (cf. Aldwin, Spiro, & Park, 2006; Schultz &

Heckhausen, 1996). We follow these more comprehensive approaches and simultaneously consider subjective well-being, medical symptoms and diseases, social competence, work competence (productivity), and longevity.

In sum, for research on personality and health to mesh with new developments in the broader field of gerontology, there is now a great need for research that includes multiple measures of health outcomes, ranging from subjective well-being to longevity. Further, such research would ideally cross long periods of time. The present study develops and includes multiple health outcomes and uses personality to predict health and longevity across more than four decades.

### Personality and Health Outcomes: Neuroticism

In an attempt to improve scientific models and construct validity, Friedman and Booth-Kewley (1987) reviewed and meta-analyzed the relations between five emotional aspects of personality (including depression and chronic anxiety) and five chronic diseases (including heart disease) thought to be especially influenced by psychosomatic factors. Two important findings emerged. First, there was a remarkably similar pattern of associations between multiple predictors and multiple disease outcomes, which contradicted the then prevalent ideas of a distinct “coronary-prone personality,” a “headache-prone personality” and so on. Friedman and Booth-Kewley referred to this broader approach as pointing to a *disease-prone personality*. Second, they found a surprisingly strong association between depression and disease, including coronary heart disease, again contradicting the conventional wisdom (which had focused on Type A behavior and hostility). The question immediately arose, however, as to whether neurotic traits like depression were good predictors of clinical disease end points or were capturing the more subjective (distress) aspects of illness (Stone & Costa, 1990). (Stone and Costa cited a study showing that neuroticism did not predict death from myocardial infarction. See also the classic paper by Watson & Pennebaker, 1989.) These issues concerning the relations of neuroticism to the subjective and objective aspects of health continue to bedevil thinking in this field, as few studies distinguish and measure the various, multiple aspects of health (including longevity).

Good evidence now exists, however, that neuroticism predicts not only distress-relevant aspects of health (DeNeve & Cooper, 1998)

but also disease incidence. A comprehensive and incisive recent review focusing on heart disease (Suls & Bunde, 2005) concluded that a “large body of evidence relating negative emotions to CHD risk has accumulated in the last three decades. . . . [T]here is supportive evidence particularly for depression and anxiety from prospective studies of initially healthy samples” (p. 284; see also Charles, Gatz, Kato, & Pedersen, 2008; Terracciano, Lockenhoff, Zonderman, Ferrucci, & Costa, 2008). Yet there is still considerable uncertainty about the construct validity of the various pieces of the causal models. For example, using data from the Veterans Affairs Normative Aging Study, Mroczek and Spiro (2007) found that the *change* in neuroticism over a 12-year period was important to longevity outcomes, suggesting the need to understand the contextual effects. As another review put it when reviewing the Friedman and Booth-Kewley ideas, “The research reviewed here suggests that emotionally distressed persons may indeed be disease prone, but the two types of associations [disease-prone vs. distress-prone] must be carefully distinguished” (T. W. Smith & Gallo, 2001, p. 154). Thus, the current project investigates the relations of neuroticism to the more subjective *and* the more objective indices of health and longevity, using an initially healthy sample, followed over a long period of time.

#### Personality and Health Outcomes: Incorporating Multiple Personality Traits

The other outgrowth of the Friedman and Booth-Kewley (1987) analyses was recognition of the importance of employing multiple predictors in the same study; this is now often done, using the five-factor approach to personality (Friedman, 2007). But current understanding that health is much more than the absence of disease requires that we go further—employing multiple health outcomes as well as multiple predictors. That is, the new paradigm in 1987 was “whether or not various diseases seem to be associated with particular personalities” (Friedman & Booth-Kewley, 1987, p. 551), but the (broader) question now is whether various aspects of health are associated with particular personalities. Thus, this paper examines four core personality dimensions as predictors of the various indices of health and longevity as people age. In addition to neuroticism, we include agreeableness, conscientiousness, and extraversion.

### Sex Differences

There is mixed evidence for sex differences in health and well-being. Most clearly, women live longer than men. The reasons for the gap remain unclear but likely involve a variety of factors, including many that depend on social roles (Rogers, Hummer, & Nam, 2000; Wingard, 1984). Men are more susceptible to infection and injury, whereas women face more functional limitations, cognitive decline, and psychological disturbances like depression (Kruger & Nesse, 2006; Macintyre, Hunt, & Sweeting, 1996; J. Smith & Baltes, 1998). For self-report aspects of health, women tend to report more symptoms of disease and psychological distress but not always lower levels of self-rated health (Gold, Malmberg, McClearn, Pedersen, & Berg, 2002; Jylhä, Guralnik, Ferrucci, Jokela, & Heikkinen, 1998). Further, women may include a broader range of factors in their self-evaluations, as the sociocultural context influences gender-relevant health patterns (Bourque, Pushkar, Bonneville, & Béland, 2005; Hyde, 2007; Pinguart & Sörensen, 2001). Women are also much more likely to be widowed and are much less likely to be employed. Overall, older men and women may face a very different set of challenges and perceptions. These striking health variations suggest that relations between personality and health may differ between men and women. Therefore we include attention to sex differences.

### The Present Study

The current project followed up on data from the Terman Life Cycle Study (begun in 1921–1922) by collecting death certificates (through 2007) and by creating new indices to define different elements of healthy aging. Participants have been followed throughout their lives and until death, allowing a look at lifelong links to health and longevity (cf. T. W. Smith & Spiro, 2002). Our past research has involved intensive empirical study to develop and validate psychosocial measures within the archival data and has investigated effects of personality, marital status, education, health behaviors, and related psychosocial aspects on mortality risk across eight decades (e.g., Friedman et al., 1993, 1995; Kern & Friedman, 2009; Martin et al., 1995; Martin & Friedman, 2000; Martin, Friedman, & Schwartz, 2007; Schwartz et al., 1995; Tucker et al., 1997). The present study extends this research by incorporating multiple measures of health in older age to capture the complex nature of aging and

includes multiple personality predictors. A conceptual aim is to provide a more comprehensive framework for studying personality–health relationships across the life span. There were four specific questions addressed:

1. What dimensions of health outcomes can be usefully distinguished as core aspects of individual differences in healthy aging? This focus involves identifying items in the dataset that address different components of healthy aging and using a combination of theory, rational analysis, and empirical testing to create a composite scale for each component. This includes examination of how the different aging components relate to longevity.
2. What is the relationship of neuroticism in midlife to healthy aging decades later? In particular, how is neuroticism related to later subjective well-being, physical health, and longevity when all are studied in the same sample?
3. How do other core aspects of personality relate to healthy aging? That is, which aspects of personality (agreeableness, conscientiousness, and extraversion) in an initially healthy sample predict later health (in old age), using a multicomponent measure of healthy aging?
4. Given well-documented sex differences in health and longevity, how do men and women differ in personality–health relations? Which personality factors are most relevant, and do these relations differ across health dimensions?

## METHOD

The Terman Life Cycle Study was initiated in 1921–1922 by Lewis Terman as a study of intelligent children in California (Terman et al., 1925). Participants were followed throughout their lives, with evaluations every 5 to 10 years. Since 1991, our research team has supplemented this information by collecting death certificates and constructing and validating new psychosocial indexes (Friedman, 2000; Friedman et al., 1993, 1995; Martin & Friedman, 2000). The present study drew on personality data derived from questions asked in 1940 (in young adulthood, average age 29) and outcome data from the 1986 assessments (when the participants were in their 70s). Longevity data were collected through 2007, thus constituting up to 67 years of follow-up. The first part of the current



study determined which items from the 1986 assessment best defined each component of healthy aging, resulting in a set of composite variables. We then used these composite variables and longevity as health outcomes.

### *Participants*

In 1921–1922, teachers in California were asked to identify the youngest and brightest children in their classes; these children were tested using the Stanford Binet Intelligence Test and included in the study if they had an IQ of 135 or greater (Terman et al., 1925). Children were added through 1928, yielding a total sample size of 1,528 (856 boys, 672 girls). For the present study, participants were excluded if they were missing all 1940 personality information and 1986 health information ( $n = 216$ ), leaving a final sample of 1,312 participants (732 men, 580 women). In addition, some analyses (with healthy aging) were limited to participants who completed the 1986 assessment ( $n = 720$ ), as described below. The mean birth year was 1911 ( $SD = 3.65$  years, range = 1900–1925).

### *Item Reduction to Measure Healthy Aging*

To define the healthy aging constructs according to the multidimensional framework described above, all items from the extensive 1986 assessment were compiled. Eight potential facets of health (physical health, mental health, cognitive functioning, life satisfaction, social competence, autonomy, productivity, coping ability) were defined (see the Appendix). Irrelevant items were excluded from further examination and remaining items were compiled into a 129-item rating form. Six trained psychology graduate students rated how well each item described each category, using a 7-point Likert scale. Each item was rated on every category, allowing items to fall into multiple categories. (Note: For the final outcome variables, no overlap between categories and items was allowed.) No items well fit a “coping ability” category, so it was not included in further analyses. Items that fit poorly across all health and well-being categories (e.g., “religion has increased in importance over the past few years”) were excluded from further consideration.

Next, we empirically evaluated the remaining items for skew, bimodal distributions, and outliers; some items were transformed or recoded to better normalize the distributions. Interitem correlations were computed. We then performed an exploratory factor analysis on the archival items to empirically evaluate whether items grouped together in accordance with the graduate student ratings. The factor analysis included 43 items with responses from 720 individuals. Several criteria were used to determine the total number of factors that best describe the data, based on the

eigenvalues (the Kaiser-Gutman criteria and scree plot). Factors were rotated using varimax and oblimin rotations. In this exploratory analysis, items aligned well with the groupings we had identified rationally, with a five-factor structure being most interpretable.

Three graduate students then sorted the 43 items, forcing items into single categories. If disagreement occurred, discussion was used to reach a consensus on the appropriate category for the item. Table 1 indicates the final definitions for each healthy aging component. A final confirmatory factor analysis was performed, using the five-factor structure. Items fit the structure identified by the raters, except that two of the physical health items (trouble with seeing and trouble with hearing) loaded poorly; as vision and hearing may reflect perception rather than health per se, we removed these from the physical health category. Although theoretically important, the cognitive scale did not demonstrate adequate reliability (three items, Cronbach's  $\alpha = .38$ ), most likely because of few cognitive-type items being available on the 1986 questionnaire and the categorical nature of these items; it also lacked content validity. So it was not included in the main analyses. However, due to the theoretical importance of the scale, we conducted additional analyses with this scale, and note the results in footnotes.<sup>1</sup> Thus, in the final model, we removed the cognitive factor and the two vision and hearing items, leaving 38 items fit to a four-factor structure (physical health, subjective well-being, social competence, and productivity). This final model provided a good fit to the data, supported both empirically and rationally.

*Final healthy aging variables.* The items identified for each category were standardized and summed to create a total composite score. Table 2 indicates the items included in each category. The categories contained the following number of items: physical health, 10 items (Cronbach's  $\alpha = .75$ ); subjective well-being, 10 items ( $\alpha = .71$ ); social competence, 8 items ( $\alpha = .71$ ); and productivity, 10 items ( $\alpha = .72$ ). The final composite variables were examined for meeting the basic assumptions of regression analysis. As a certain degree of skew was apparent, the four composite variables were transformed using a square root transformation. These

1. The cognitive items were combined and scaled on a 0 to 2 scale (0 = *no problems reported*, 1 = *some trouble with memory or concern of cognitive decline*, 2 = *much trouble with memory or noticeable cognitive decline*). As expected in an intelligent cohort, 67% of the sample reported no cognitive problems, and only 6% reported major concerns about cognitive decline. Men and women were equally likely to report cognitive trouble. Our cognitive analyses most likely underestimate any associations between variables.

**Table 1**  
Final Category Definitions for Each Component of Healthy Aging

Category	Definition
Physical health	Refers to the degree of a person's physical well-being, in a medical sense. Good physical health involves not being sick (e.g., fever) or having major morbid (disease) conditions (such as cancer, heart disease), and functioning well physically without needing much medical care.
Subjective well-being	Refers to the psychological well-being of a person and how satisfying a person believes his or her life is. Good subjective well-being involves good mental adjustment and having a positive acceptance of one's life in general.
Cognitive functioning <sup>a</sup>	Refers to a person's cognitive capacity: how well a person can think, remember things, and cognitively respond to the world. Good cognitive functioning involves an ability to engage in cognitively demanding tasks and a lack of significant memory problems or signs of dementia.
Social competence	Refers to how well a person interacts with others. Social competence involves positively interacting with others, engaging in activities with other people, and having a suitable social network.
Productivity	Refers to what a person strives to accomplish and contributes to family or society. Productivity involves having concrete goals to contribute to society, remaining active in work activities (paid or unpaid), and continuing to accomplish things.

*Note:* See Table 2 for the actual items used to capture these components of healthy aging.

<sup>a</sup>Cognitive functioning was not reliably assessed in this study and is included only for completeness; associations with cognitive function/trouble, which are footnoted, should be interpreted with caution.

final variables were used in all subsequent analyses. Healthy aging variables were available for 720 participants (381 men, 339 women).

### *Personality Measures*

Personality was assessed in 1940 (in early adulthood). The assessment included 53 items selected from the Bernreuter Personality Inventory

**Table 2**  
Items Included in Each Category

Scale	Item
Physical health ( $\alpha = .75$ )	<p>In general, my health has been good over the past few years</p> <p>I have cancer (R)</p> <p>I have a chronic heart condition (R)</p> <p>I have had several illnesses over the past few years (R)</p> <p>I have recently been troubled by declining health (R)</p> <p>I have recently been troubled by declining muscular strength or control (R)</p> <p>I have recently been troubled by not having enough personal energy</p> <p>I can complete daily tasks with little or no assistance</p> <p>I have an adequate energy/vitality level at this period of my life for a full range of activities</p> <p>As I look back over my life, excellent health has contributed to my life accomplishments</p>
Subjective well-being ( $\alpha = .71$ )	<p>Over the past few months, I have generally been in a positive mood</p> <p>Over the past few months, I have generally felt fairly calm or relaxed</p> <p>Taking things altogether, I would describe myself as pretty happy</p> <p>In the last few years, several disappointments or failures have exerted an influence on me (R)</p> <p>I am concerned about my mental health declining (R)</p> <p>Several aspects of my health give me cause to worry about my well-being over the next few years (R)</p> <p>I am satisfied with my current living situation</p> <p>I am satisfied with my interactions with others</p> <p>I am satisfied with the quality and availability of my health care</p> <p>In looking back over my life, I am satisfied with the choices I made</p>
Social competence ( $\alpha = .71$ )	<p>I informally visit friends, neighbors, children</p> <p>I often interact with others on a close, personal basis</p> <p>A goal or purpose of my life is to enjoy intimacy with others</p> <p>A goal or purpose in my life is to have many pleasant relationships</p> <p>I attend meetings of social groups or clubs</p>

(Continued)

**Table 2 (Cont.)**

Scale	Item
	I do community service with organizations
	I help others (friends, neighbors, children)
	As I look back over my life, good social adjustment has contributed to my life accomplishments
Productivity ( $\alpha = .72$ )	I continue to pursue educational opportunities or increase my knowledge and skill
	I continue to work part-time or full-time for pay
	A goal or purpose of my life is to continue to grow personally, be creative, and productive
	A goal or purpose of my life is to continue to work
	A goal or purpose of my life is to continue to have opportunities for achievement or competition
	A goal or purpose of my life is to continue to produce social change
	A goal or purpose of my life is to make a contribution to society
	Over the past few years, I have received special honors or awards
	I consider myself more ambitious or aspiring than my friends and colleagues in regard to excellence in whatever project I now engage in
	As I look back over my life, persistence in working toward a goal has contributed to my life accomplishments
Cognitive function ( $\alpha = .38$ )	I have experienced significant cognitive decline over the past few years
	I am concerned about my cognitive decline or memory loss
	I have been troubled by misplacing things or a poor memory

*Note.* (R) indicates reversed scored items.

(Bernreuter, 1933) and 14 additional self-ratings on personality traits. We created and validated scales using rational analysis and empirical comparisons with the NEO PI-R (see Martin & Friedman, 2000). Scales were labeled as agreeableness (11 items,  $\alpha = .72$ ), conscientiousness (7 items,  $\alpha = .65$ ), neuroticism (17 items,  $\alpha = .85$ ), and extraversion (7 items,  $\alpha = .65$ ). Openness could not be assessed in this sample, due to the sample's selection on correlates of this dimension (intelligence) and the paucity of relevant item choices by Terman. Personality data were available for 1,234 participants (693 men, 541 women).

*Midlife Health and Adjustment as Control Variables*

To control for baseline health and adjustment, we included three measures at midlife: self-reported health, Terman-rated mental adjustment, and alcohol abuse. In 1950, participants reported their general health over the last few years on a 5-point Likert scale. As very few individuals reported very low health, we combined very poor and poor health, resulting in a 4-point health scale (1 = *very poor health*, 4 = *very good health*). In 1950, Terman and his colleagues rated participants on how well they were adjusted mentally, based on self-report questions, case histories, and personal correspondence (1 = *maladjusted*, 2 = *some adjustment problems*, 3 = *well adjusted*). Finally, alcohol abuse can be a marker of mental maladjustment, and high use has been linked to worse health outcomes. Participants self-reported their alcohol usage (1 = *none or very rarely*, 2 = *moderate*, 3 = *heavy use or alcohol is a problem*). Data were available for 1,193 participants (666 men, 527 women) for midlife health, 1,190 participants (663 men, 527 women) for midlife mental adjustment, and 1,188 participants (664 men, 524 women) for alcohol abuse.

*Longevity*

We collected death certificates (from state and county agencies throughout the country) through 2007 to determine year and age of death. For some participants ( $n = 97$ ), death certificates could not be located, but relatives reported death information. Death status was ascertained for 1,132 participants (665 men, 467 women).

*Data Analyses*

Hierarchical linear regression was used to predict the healthy aging components (physical health, subjective well-being, social competence, and productivity), and Cox proportional hazards regression (survival analysis) was used to predict mortality risk. First, to help validate the healthy aging scales, survival analyses were used to test the relation of each healthy aging component to mortality risk. We expected that physical health would be most strongly related to mortality risk. Second, to examine the relation between neuroticism and later health, we predicted healthy aging (from neuroticism) using linear regression, and Cox proportional regression was used to predict mortality risk associated with neuroticism. Third, to examine other core aspects of personality, we included conscientiousness, agreeableness, and extraversion in the regression and survival models. Finally, we added midlife health and adjustment controls to these regression and survival models. As

male-female differences were expected, all analyses were conducted with the full sample, separately by sex, and by including an interaction term between sex and personality.

Analyses were performed using SAS software, version 9.1. The healthy aging and personality scales lack a natural metric; therefore, for ease of understanding with the survival analyses, the measures were rescaled to the interquartile range of the scale. This scaling makes the survival parameters estimate the difference in the log hazard ratio for individuals at the 25th and 75th percentiles, controlling for the effects of the other variables in the equation.

## RESULTS

Participants who completed the 1986 measures ( $n = 720$ ) are a select group of individuals who lived to older age and may differ from the original full sample. Therefore, we compared the 1940 personality variables and the 1950 health/adjustment variables for the 720 individuals who completed the 1986 assessment to the 592 noncompleters. Completers were more agreeable,  $t(1232) = 2.17$ ,  $r = .06$ ,  $p = .03$ , better mentally adjusted,  $t(1188) = 2.14$ ,  $r = .06$ ,  $p = .03$ , and used less alcohol,  $t(1186) = 3.07$ ,  $r = .09$ ,  $p = .002$ . By 1986, 431 participants had passed away (and therefore could not complete the assessment). The remaining 161 individuals (80 men, 81 women) were still alive (to the best of our knowledge) but did not participate in the assessment. We compared the personality and health/adjustment variables for the 720 completers to the 161 living noncompleters; no differences were found. Note that any study of healthy aging will necessarily exclude those who died at a younger age, and so such analyses, coupled with longevity survival analyses, help give a more complete picture. We report mortality risk results for the full sample and for the group that completed the 1986 assessment.

As expected, men and women differed significantly on most variables. In 1940, women were more neurotic than men, full sample:  $t(1232) = 4.81$ ,  $r = .14$ ,  $p < .0001$ ; 1986 cohort:  $t(640) = 3.02$ ,  $r = .12$ ,  $p = .003$ , less conscientious, full sample:  $t(1232) = -3.76$ ,  $r = -.11$ ,  $p = .0002$ ; 1986 cohort:  $t(640) = -2.92$ ,  $r = -.12$ ,  $p = .004$ , more agreeable, full sample:  $t(1232) = 6.63$ ,  $r = .19$ ,  $p < .0001$ ; 1986 cohort:  $t(640) = 4.47$ ,  $r = .17$ ,  $p < .0001$ , and more extraverted, full sample:  $t(1232) = 2.42$ ,  $r = .07$ ,  $p = .02$ ; 1986 cohort:  $t(640) = 2.05$ ,  $r = .08$ ,  $p = .04$ . In 1950, women rated themselves as less healthy, full sample:

$t(1191) = -3.28, r = -.10, p = .001$ ; 1986 cohort:  $t(688) = -2.55, r = -.10, p = .01$ , and used less alcohol, full sample:  $t(1186) = -7.55, r = -.22, p < .0001$ ; 1986 cohort:  $t(687) = -5.55, r = -.21, p < .0001$ . In 1986, women reported lower subjective well being,  $t(718) = -5.05, r = -.19, p < .0001$ , higher social competence,  $t(718) = 5.76, r = .21, p < .0001$ , and less productivity,  $t(718) = -3.80, r = -.14, p = .0002$ . Using survival analyses (which incorporate censored observations), women were at a lower mortality risk, full sample: relative hazard [rh] (1312) = .77, [95% confidence interval (CI) = 0.68, 0.86],  $p < .0001$ ; 1986 cohort:  $\text{rh}(720) = .77$  [CI = 0.65, 0.90],  $p = .002$ . These differences should be kept in mind when considering the results presented below.

### *Validating the Healthy Aging Components Via Relations to Mortality Risk*

By 2007, 1,132 of the participants (86%) were confirmed to be dead (665 men, 467 women). Using the Kaplan-Meier estimate, the median age of death was 80.1 years (CI = 79.3, 80.6) for men and 83.1 years (CI = 82.0, 84.4) for women. For the 1986 subgroup, 586 participants (81.4%) were confirmed to be dead (330 men, 256 women). The median age of death for these participants (who had reached old age) was 85.0 years (CI = 84.2, 85.7) for men and 87.7 years (CI = 86.5, 88.7) for women. This longevity is not particularly surprising for a cohort that was alive and healthy at age 11 and, for the 1986 cohort, had already survived to old age. We have shown previously that the longevity *patterns* follow those of the general population cohort, though are somewhat extended (see Friedman & Markey, 2003).

As a partial validation of the healthy aging components, we examined the relation of the components to longevity (Cox analyses in the 1986 cohort). As expected, physical health was the strongest predictor of mortality risk, men:  $\text{rh}(381) = 0.55$  [CI = 0.45, 0.66],  $p < .0001$ ; women:  $\text{rh}(339) = 0.63$  [CI = 0.52, 0.76],  $p < .0001$ , followed by productivity, men:  $\text{rh}(381) = 0.71$  [CI = 0.60, 0.83],  $p < .0001$ ; women:  $\text{rh}(339) = 0.66$  [CI = 0.53, 0.82],  $p = .0003$ , and social competence, men:  $\text{rh}(381) = 0.84$  [CI = 0.72, 0.98],  $p = .02$ ; women:  $\text{rh}(339) = 0.70$  [CI = 0.58, 0.86],  $p = .0004$ . Subjective well-being was not predictive of mortality risk, men:  $\text{rh}(381) = 1.03$  [CI = 0.90, 1.19],  $p = .68$ ; women:  $\text{rh}(339) = 0.88$  [CI = 0.76, 1.03],



$p = .12$ . These differential effects suggest that physical health, subjective well-being, and longevity can and should be distinguished.<sup>2</sup>

### *Neuroticism and Health*

The second goal of our study was to examine how neuroticism, measured in 1940, relates to older age health and longevity. Correlations between the personality, midlife health/adjustment variables, and older age health are presented in Table 3. We used standard multiple regression to predict each health component from neuroticism, controlling for age. Across more than four decades, neuroticism most strongly predicted (poor) late-life subjective well-being,  $n = 642$ ,  $\beta = -.34$ ,  $t = -7.64$ ,  $p < .0001$ , but also predicted worse health in 1986 across the other three domains, physical health:  $\beta = -.31$ ,  $t = -5.30$ ,  $p < .0001$ ; social:  $\beta = -.11$ ,  $t = -2.12$ ,  $p = .03$ ; productivity:  $\beta = -.12$ ,  $t = -2.11$ ,  $p = .04$ .<sup>3</sup>

Using Cox proportional hazard regression (controlling for age) in the full sample, neuroticism was not significantly related to mortality risk,  $rh(1232) = 0.98$  [CI = 0.90, 1.07],  $p = .61$ . However, there was an interaction between neuroticism and sex, interaction  $rh(1232) = 1.30$  [CI = 1.09, 1.56],  $p = .004$ . For men, neuroticism marginally predicted *lower* mortality risk,  $rh(691) = 0.90$  [CI = 0.80, 1.01],  $p = .07$ , whereas for women, neuroticism predicted *higher* mortality risk,  $rh(541) = 1.17$  [CI = 1.01, 1.34],  $p = .04$ . The 1986 cohort displayed a similar pattern of results, interaction  $rh(642) = 1.31$  [CI = 1.01, 1.70],  $p = .04$ ; male neuroticism:  $rh(342) = 0.89$  [CI = 0.75, 1.05],  $p = .16$ ; women:  $rh(300) = 1.13$  [CI = 0.92, 1.39],  $p = .25$ .

Table 4 summarizes four models: neuroticism predicting each aging component, controlling for sex (Model A), separately by sex (Models B and C), and including an interaction between neuroticism

2. Cognitive functioning (trouble) was not predictive of mortality risk,  $rh = .97$  [CI = .84, 1.11],  $p = .61$ .

3. Controlling for age, neuroticism significantly predicted cognitive functioning trouble,  $\beta = .14$ ,  $t = 3.39$ ,  $p = .0007$ . There was no interaction between neuroticism and sex, but separately by sex, neuroticism predicted cognitive trouble for men,  $\beta = .19$ ,  $t = 3.50$ ,  $p = .0005$ , but not women,  $\beta = .07$ ,  $t = 1.19$ ,  $p = .23$ . Including the other personality traits, for men, neuroticism predicted more cognitive trouble,  $\beta = .15$ ,  $t = 2.60$ ,  $p = .01$ , whereas agreeableness predicted less cognitive trouble,  $\beta = -.20$ ,  $t = -3.42$ ,  $p = .0007$ ; the personality variables were not significant predictors of cognitive trouble for women.

**Table 3**  
Pearson *r* Correlations With the Four Healthy Aging Variables

Variable ( <i>n</i> )	Physical Health	Subjective Well-being	Social Competence	Productivity
1940 Personality				
Neuroticism (642)	-.19***	-.29***	-.08*	-.07
Men (342)	-.12*	-.27***	-.09	-.03
Women (300)	-.24***	-.28***	-.13*	-.09
Conscientiousness (642)	.09*	.15***	.09*	.16***
Men (342)	.09	.12*	.12*	.20***
Women (300)	.08	.15**	.12*	.09
Agreeableness (642)	.12**	.15***	.17***	.01
Men (342)	.21***	.20***	.15**	.05
Women (300)	.07	.18**	.11*	.03
Extraversion (642)	.09*	.06	.24***	.08
Men (342)	.06	.05	.22***	.10
Women (300)	.15**	.11	.23***	.08
1950 Health and Adjustment				
Self-rated health (690)	.25***	.29***	.07*	.04
Men (368)	.22***	.23***	.14**	.07
Women (322)	.28***	.33***	.06	-.01
Mental adjustment (688)	.13***	.23***	.11**	-.02
Men (366)	.13**	.19***	.10	-.03
Women (322)	.13*	.27***	.16**	-.03
Alcohol use (689)	-.03	-.03	-.12**	-.13**
Men (367)	-.01	-.04	-.08	-.11*
Women (322)	-.08	-.09	-.08	-.22***
1986 Healthy Aging				
Physical health (720)	1.00	.48***	.20***	.26***
Men (381)	1.00	.46***	.24***	.29***
Women (339)	1.00	.50***	.21**	.21**
Subjective well-being (720)		1.00	.11**	.11**
Men (381)		1.00	.15**	.10
Women (339)		1.00	.17**	.07
Social competence (720)			1.00	.33***
Men (381)			1.00	.40***
Women (339)			1.00	.33***

(Continued)

Table 3 (Cont.)

Variable ( <i>n</i> )	Physical Health	Subjective Well-being	Social Competence	Productivity
Productivity (720)				1.00
Men (381)				1.00
Women (339)				1.00

Note: Health aging outcomes are measured in 1986.

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

and sex (Model D). For men, higher neuroticism was most predictive of low subjective well-being,  $\beta = -.30$ ,  $t = -5.14$ ,  $p < .0001$ , less predictive of physical health,  $\beta = -.19$ ,  $t = -2.44$ ,  $p = .02$ , and not significantly related to social competence,  $\beta = -.12$ ,  $t = -1.62$ ,  $p = .11$ , or productivity,  $\beta = -.05$ ,  $t = -0.61$ ,  $p = .54$ . For women, neuroticism was most relevant to physical health,  $\beta = -.43$ ,  $t = -4.70$ ,  $p < .0001$ , significantly predicted subjective well-being,  $\beta = -.34$ ,  $t = -4.97$ ,  $p < .0001$ , and social competence,  $\beta = -.19$ ,  $t = -2.52$ ,  $p = .01$ , and was marginally related to productivity,  $\beta = -.15$ ,  $t = -1.92$ ,  $p = .06$ . There was a significant interaction between sex and neuroticism in predicting physical health,  $\beta = -.24$ ,  $t = -2.07$ ,  $p = .03$ , such that low neuroticism was related to better physical health for both men and women, whereas high neuroticism related to low physical health for women but not men. The interaction term was not significant for subjective well-being,  $\beta = -.04$ ,  $t = -0.47$ ,  $p = .64$ , social competence,  $\beta = -.06$ ,  $t = -0.06$ ,  $p = .55$ , or productivity,  $\beta = -.10$ ,  $t = -0.86$ ,  $p = .39$ .

#### *Other Personality Traits and Health*

The third goal of the study was to concurrently examine the relation of other personality predictors to health outcomes. The four personality factors were entered simultaneously into the regression model. Results are summarized in Table 5.

Neuroticism remained the strongest personality predictor of subjective well-being in the full sample (controlling for sex, Table 5, Model A) and separately by sex (Models B and C). For men, agreeableness was the strongest predictor of physical health, extraversion

**Table 4**  
 Early Adult Neuroticism Predicting the Four Healthy Aging  
 Components in the 1986 Cohort Controlling for Sex (Model A),  
 Separately by Sex (Models B and C), and Including the Neuroticism  
 × Sex Interaction (Model D)

Predictors	$R^2$	$F$	$\beta$	$t$
Physical health				
Model A: Controlling for sex	0.08	18.45***		
Neuroticism			-0.30	-5.05***
Sex			-0.14	-1.97*
Model B: Men	0.06	11.13***	-0.19	-2.44*
Model C: Women	0.10	15.61***	-0.43	-4.70***
Model D: Interaction	0.09	14.98***		
Neuroticism			-0.19	-2.33*
Sex			-0.13	-1.92
Neuroticism × Sex			-0.24	-2.07*
Subjective well-being				
Model A: Controlling for sex	0.11	27.09***		
Neuroticism			-0.32	-7.18***
Sex			-0.24	-4.55***
Model B: Men	0.08	14.11***	-0.30	-5.14***
Model C: Women	0.08	12.37***	-0.34	-4.97***
Model D: Interaction	0.11	20.35***		
Neuroticism			-0.30	-4.97***
Sex			-0.24	-4.53***
Neuroticism × Sex			-0.04	-0.47
Social competence				
Model A: Controlling for sex	0.07	15.54***		
Neuroticism			-0.15	-2.83**
Sex			0.36	5.84***
Model B: Men	0.01	1.84	-0.12	-1.62
Model C: Women	0.04	6.61**	-0.19	-2.52**
Model D: Interaction	0.07	11.73***		
Neuroticism			-0.12	-1.67
Sex			0.36	5.85***
Neuroticism × Sex			-0.06	-0.60

(Continued)

Table 4 (Cont.)

Predictors	$R^2$	$F$	$\beta$	$t$
Productivity				
Model A: Controlling for sex	0.06	14.51***		
Neuroticism			-0.09	-1.68
Sex			-0.25	-3.85***
Model B: Men	0.04	6.77**	-0.05	-0.61
Model C: Women	0.06	8.71***	-0.15	-1.92
Model D: Interaction	0.07	11.06***		
Neuroticism			-0.05	-0.65
Sex			-0.25	-3.83***
Neuroticism $\times$ Sex			-0.10	-0.86

Note.  $N = 642$  (342 men, 300 women). Variables were entered simultaneously. The  $F$  and  $R^2$  test the full model (for all variables in the model, controlling for age); the  $t$  tests the individual predictor. For sex, 0 = male, 1 = female.

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

was the strongest predictor of social competence, and conscientiousness was the strongest predictor of productivity. For women, neuroticism was the strongest predictor of physical health, and extraversion was the strongest predictor of social competence.

Prior studies with the full Terman sample have examined the relation between adult personality and mortality risk and have found a strong protective effect of conscientiousness (Friedman et al., 1993; Martin & Friedman, 2000; Martin et al., 2007). Mortality risk was thus examined for this now-older sample (through 2007), using Cox proportional regression analyses, with the four personality variables simultaneously entered into the model, controlling for sex, separately by sex, and including the interaction between sex and each personality variable. Results are summarized in Table 6. Replicating previous findings, in the full sample, conscientiousness was predictive of lower mortality risk,  $rh(1232) = 0.87$  [CI = 0.80, 0.95],  $p = .003$ . Separately by sex, conscientiousness significantly predicted lower mortality risk for women,  $rh(541) = 0.80$  [CI = 0.70, 0.92],  $p = .002$ , and trended that way for men,  $rh(691) = 0.91$  [CI = 0.80, 1.02],  $p = .11$ .

Consistent with the single-variable models presented above, neuroticism predicted lower mortality risk for men,  $rh(691) = 0.87$  [CI = 0.77,

**Table 5**  
 Early Adult Personality Predicting the Four Healthy Aging  
 Components in the 1986 Cohort Controlling for Sex (Model A) and  
 Separately by Sex (Models B and C)

Predictors	$R^2$	$F$	$\beta$	$t$
Physical health				
Model A: Controlling for sex	0.10	11.48***		
Neuroticism			-0.24	-3.87***
Conscientiousness			0.09	1.53
Agreeableness			0.18	3.01**
Extraversion			0.05	0.90
Sex			-0.18	-2.47**
Model B: Men	0.11	8.54***		
Neuroticism			-0.10	-1.22
Conscientiousness			0.13	1.71
Agreeableness			0.31	3.99***
Extraversion			0.02	0.29
Model C: Women	0.10	6.57***		
Neuroticism			-0.39	-4.06***
Conscientiousness			0.06	0.65
Agreeableness			0.03	0.36
Extraversion			0.09	1.03
Subjective well-being				
Model A: Controlling for sex	0.13	17.19***		
Neuroticism			-0.27	-5.73***
Conscientiousness			0.08	1.74
Agreeableness			0.18	3.84***
Extraversion			0.05	1.14
Sex			-0.28	-5.19***
Model B: Men	0.11	7.97***		
Neuroticism			-0.25	-4.07***
Conscientiousness			0.06	1.04
Agreeableness			0.19	3.09**
Extraversion			0.03	0.61
Model C: Women	0.11	6.93***		
Neuroticism			-0.28	-3.93***
Conscientiousness			0.10	1.46
Agreeableness			0.16	2.31*
Extraversion			0.06	0.95

(Continued)

**Table 5 (Cont.)**

Predictors	$R^2$	$F$	$\beta$	$t$
Social competence				
Model A: Controlling for sex	0.13	16.02***		
Neuroticism			-0.05	-0.90
Conscientiousness			0.15	2.98**
Agreeableness			0.16	3.13***
Extraversion			0.25	5.32***
Sex			0.31	5.07***
Model B: Men	0.10	7.19***		
Neuroticism			-0.01	-0.13
Conscientiousness			0.17	2.49*
Agreeableness			0.22	2.98**
Extraversion			0.29	4.48***
Model C: Women	0.09	5.75***		
Neuroticism			-0.10	-1.27
Conscientiousness			0.12	1.75
Agreeableness			0.10	1.38
Extraversion			0.21	2.96**
Productivity				
Model A: Controlling for sex	0.09	11.04***		
Neuroticism			-0.02	-0.27
Conscientiousness			0.24	4.47***
Agreeableness			0.04	0.62
Extraversion			0.05	0.91
Sex			-0.24	-3.65***
Model B: Men	0.10	7.69***		
Neuroticism			0.08	1.01
Conscientiousness			0.37	4.71***
Agreeableness			0.08	0.96
Extraversion			0.10	1.34
Model C: Women	0.06	3.96**		
Neuroticism			-0.12	-1.50
Conscientiousness			0.12	1.54
Agreeableness			0.00	0.02
Extraversion			-0.00	-0.02

Note.  $N = 642$  (342 men, 300 women). Variables were entered simultaneously. The  $F$  and  $R^2$  test the full model (for all variables in the model, controlling for age); the  $t$  tests the individual predictor. For sex, 0 = male, 1 = female.

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

**Table 6**  
 Cox Survival Analyses Predicting Mortality Risk From 1940 Personality  
 and Sex

Model	<i>B</i>	Relative Hazard	<i>p</i>	95% Confidence Interval
Combined, full sample ( <i>N</i> = 1,232)				
Neuroticism	-0.06	0.94	0.19	0.85, 1.03
Conscientiousness	-0.14	0.87	0.003	0.80, 0.95
Agreeableness	-0.07	0.93	0.13	0.85, 1.02
Extraversion	-0.02	0.98	0.73	0.90, 1.08
Sex	-0.24	0.79	<0.001	0.70, 0.90
Combined, 1986 cohort ( <i>n</i> = 642)				
Neuroticism	-0.07	0.93	0.31	0.81, 1.07
Conscientiousness	-0.12	0.88	0.07	0.77, 1.01
Agreeableness	-0.04	0.96	0.51	0.84, 1.09
Extraversion	0.03	1.03	0.65	0.90, 1.18
Sex	-0.24	0.79	0.01	0.66, 0.94
Men, full sample ( <i>n</i> = 691)				
Neuroticism	-0.14	0.87	0.02	0.77, 0.98
Conscientiousness	-0.10	0.91	0.11	0.80, 1.02
Agreeableness	-0.06	0.94	0.30	0.83, 1.06
Extraversion	0.01	1.01	0.86	0.89, 1.14
Men, 1986 Cohort ( <i>n</i> = 342)				
Neuroticism	-0.14	0.87	0.14	0.73, 1.05
Conscientiousness	-0.05	0.95	0.60	0.80, 1.14
Agreeableness	-0.03	0.97	0.74	0.82, 1.15
Extraversion	0.04	1.04	0.68	0.87, 1.24
Women, full sample ( <i>n</i> = 541)				
Neuroticism	0.08	1.08	0.31	0.93, 1.26
Conscientiousness	-0.22	0.80	0.002	0.70, 0.92
Agreeableness	-0.08	0.93	0.28	0.80, 1.07
Extraversion	-0.03	0.97	0.67	0.84, 1.12
Women, 1986 cohort ( <i>n</i> = 300)				
Neuroticism	0.09	1.09	0.44	0.87, 1.36
Conscientiousness	-0.30	0.74	0.003	0.61, 0.90
Agreeableness	-0.04	0.96	0.69	0.79, 1.17
Extraversion	0.08	1.08	0.47	0.87, 1.34

*Note.* "Full sample" refers to all participants with 1940 personality data. "1986 cohort" refers to those with both 1940 personality data and 1986 (older age health) data. Variables were entered simultaneously; all analyses control for age. For personality variables, interquartile hazards are presented (the betas and relative hazards compares those at the 75th percentile with those at the 25th percentile); higher numbers mean higher scores on that trait.

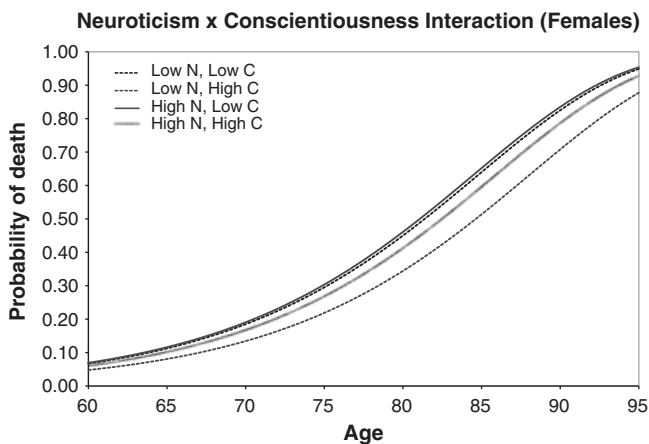


0.98],  $p = .02$ , but somewhat higher risk for women,  $rh(541) = 1.08$  [CI = 0.93, 1.26],  $p = .31$ . Again, there was a significant interaction between sex and neuroticism, interaction  $rh(1232) = 1.27$  [CI = 1.04, 1.54],  $p = .02$ . The other Personality  $\times$  Sex interaction terms were not significant, conscientiousness:  $rh = 0.89$  [CI = 0.74, 1.07],  $p = .23$ ; agreeableness:  $rh = 0.99$  [CI = 0.83, 1.20],  $p = .95$ ; extraversion:  $rh = 0.97$  [CI = 0.81, 1.17],  $p = .78$ ). The 1986 cohort demonstrated similar trends across these analyses.

Because of the theoretical and empirical importance of neuroticism and conscientiousness to understanding health, additional analyses were computed using the statistical interactions between neuroticism and conscientiousness in both the standard regression and survival analyses. The interaction term was not a significant predictor of the healthy aging components for either men or women but was significant for mortality risk for women, interaction  $rh(541) = 1.27$  [CI = 1.03, 1.57],  $p = .03$ , in the full sample. Women low on conscientiousness were at the highest mortality risk, regardless of the level of neuroticism. Women high on conscientiousness and low on neuroticism were at the lowest mortality risk (see Figure 1).

*Controlling for Midlife Health and Adjustment*

To examine possible health-relevant midlife influences, we estimated a final set of regression and survival models that included mental



**Figure 1**  
 Interaction between neuroticism and conscientiousness predicting mortality risk through 2007, for women.

adjustment (Terman rated), self-rated health, and alcohol abuse, reported in the 1950 assessment. Notably, including these variables in the regression models did not significantly change the pattern of results for the personality variables. Nevertheless, for archival purposes, the relations were as follows. Self-rated health predicted better physical health,  $\beta = 0.32$ ,  $t(686) = 6.26$ ,  $p < .0001$ , and subjective well-being,  $\beta = 0.24$ ,  $t(686) = 6.25$ ,  $p < .0001$ , marginally predicted social competence,  $\beta = 0.08$ ,  $t(686) = 1.72$ ,  $p = .09$ , and was not reliably related to productivity,  $\beta = 0.07$ ,  $t(686) = 1.33$ ,  $p = .18$ . Mental adjustment predicted higher subjective well-being,  $\beta = 0.18$ ,  $t(686) = 3.94$ ,  $p < .0001$ , and social competence,  $\beta = 0.13$ ,  $t(686) = 2.50$ ,  $p = .01$ , and was not reliably related to physical health,  $\beta = 0.09$ ,  $t(686) = 1.52$ ,  $p = .13$ , or productivity,  $\beta = -0.09$ ,  $t(686) = -1.56$ ,  $p = .12$ . Alcohol abuse predicted lower productivity,  $\beta = -0.30$ ,  $t(686) = 4.80$ ,  $p < .0001$ , marginally predicted lower social competence,  $\beta = -0.11$ ,  $t(686) = -1.93$ ,  $p = .06$ , but was not quite reliably related to later physical health,  $\beta = -0.09$ ,  $t(686) = -1.44$ ,  $p = .15$ , or subjective well-being,  $\beta = -0.08$ ,  $t(686) = -1.61$ ,  $p = .11$ .<sup>4</sup> Men and women demonstrated similar patterns across these variables. In the full sample (controlling for sex), higher alcohol use (abuse) was associated with increased mortality risk,  $rh(1186) = 1.25$  [CI = 1.10, 1.41],  $p < .0001$ . Including the midlife adjustment and self-rated health variables with personality in the survival analyses did not significantly change the pattern of results. For example, neuroticism remained predictive of lower mortality risk for men,  $rh(627) = 0.79$  [CI = 0.68, 0.91],  $p = .001$ , and conscientiousness remained a significant predictor of lower mortality risk for women,  $rh(492) = 0.82$  [CI = 0.70, 0.95],  $p = .01$ .

## DISCUSSION

The early study of personality and health was hindered by a focus on single variable predictors (such as hostility or Type A) of a single disease (such as coronary disease), and this was redressed with

4. Midlife mental adjustment predicted less cognitive trouble in the full sample,  $\beta = -0.17$ ,  $t(686) = -3.96$ ,  $p < .0001$ . Physical health and alcohol use were not significantly related to cognitive trouble. Including the midlife health and adjustment variables did not significantly change the neuroticism and agreeableness relations with cognitive trouble.

attention to multiple trait predictors of multiple diseases. A key challenge today is to expand the framework further, with multiple aspects of health as the outcome and with longer periods of time. The present study derived promising health outcome categories from previous conceptualizations and was able to validate empirically a number of useful categories for this Terman data set, including physical health (absence of serious chronic disease and physical decline), subjective well-being (mood, life satisfaction, perceived mental health), social competence (good relations and ties with others), and productivity (goals to contribute, work, purpose). We also included longevity as an objective and key measure of health. Importantly, the results show that these health outcomes related differentially to personality traits measured much earlier in life.

As would be expected, physical health was most closely related to longevity. The physical health scale is fairly objective because it includes items about cancer, heart conditions, and daily tasks; but it is still a self-report measure that includes judgments about health, and so it is also correlated with subjective well-being. Subjective well-being was *least* closely related to longevity. In fact, subjective well-being tended to be not associated with mortality risk when separated from other aspects of health. This is consistent with the equivocal results of studies endeavoring to relate positive affect to survival (Pressman & Cohen, 2005). The causes of this variation are still unknown, but one might speculate about persons who feel good but are carefree and ignore medical care or prescribed treatment or have unhealthy habits. Studies of subjective well-being or positive affect also often inadvertently capture many confounding variables such as current physical health, socioeconomic status, health behaviors, social integration, and more. It may be nothing about subjective well-being (happiness, positive mood, life satisfaction) per se that is important to longevity in a causal sense. This issue remains a topic for future research.

Neuroticism (in its relations to health) has long been a source of confusion and controversy in personality and health psychology. There is no doubt that anxiety, depression, hostility, and vulnerability are not generally markers of the most robust health, but the precise linkages have been difficult to uncover. On the one hand, there are multiple causal links between personality and health operating simultaneously (Friedman, 2007), including reverse causation

and underlying third variables, bringing inherent complexity. Long-term multivariate studies are thus essential. On the other hand (and one focus of the current research), there is confusion engendered by imprecise definitions of health outcomes. The current study is the first to use neuroticism as a long-term predictor of subjective well-being, physical health, *and* longevity.

Impressively, over more than four decades, neuroticism did indeed predict late-life outcomes, especially subjective well-being. The mechanisms remain unknown, but effects on subjective well-being might especially involve increased susceptibility to pain (by the highly sensitive highly neurotic; Charles et al., 2008) or may be partly artifactual. Importantly, although neuroticism was strongly predictive of (worse) late life subjective well-being, it was less consistently predictive of late life physical health (which was correlated with subjective well-being) and longevity. Although long-term patterns of being angry or depressed (or both) can clearly sometimes lead to behaviors or stresses that increase mortality risk (Neupert, Mroczek, & Spiro, 2008; Suls & Bunde, 2005; Terracciano et al., 2008), many studies show no relation between neuroticism and longevity, and at least two other published studies show the possibility of a protective effect of neuroticism (Korten et al., 1999; Weiss & Costa, 2005).

Perhaps neuroticism becomes beneficial in the face of certain life challenges, as worriers take more appropriate action (Taga, Friedman, & Martin, 2009). This benefit might be especially true of older or widowed men, who are more likely to be socially isolated and in need of motivation to protect their health. There may also be selection artifacts, where those at high risk from a certain personality trait die at a young age. Such new conceptions of neuroticism and health can supersede the old “either–or” distinction between being disease prone or distress prone. Both are relevant, and it remains for future research to tease apart the causal mechanisms for each link. Much more attention should also be directed at possible methodological assessment artifacts, such as the overlap between physical and mental health (which we began to separate in this study). For example, it may be that individuals low on neuroticism (or high on subjective well-being) in old age are also healthier in various ways, and, if this is not controlled, some short-term studies are merely finding that healthy people stay healthier or live longer.

Our findings on the various personality traits, healthy aging, and longevity suggest that a much more differentiated approach to

personality and health may indeed prove fruitful. By combining theory based on the existing literature, rational assessment, and empirical analysis, four facets of health were successfully identified: physical health, subjective well-being, social competence, and productivity. (Cognitive functioning in old age could not yet be reliably measured in these data but is very likely an important fifth facet.) Just as we differentiate personality traits, it will likely prove fruitful to better differentiate health outcomes. It is interesting, for example, that the social competence aspect of healthy aging was well predicted by extraversion, but extraversion was not otherwise as relevant to health and longevity.

Differences between men and women in personality–health relations were expected, and many differences were found. Most notably, women high on conscientiousness and low on neuroticism were at especially low mortality risk in the ensuing decades. Such women were also physically, socially, and subjectively healthier in older age. Although these data did not allow an explicit tracing of the relevant causal pathways, it seems likely that such women tended to be higher on all the psychosocial dimensions known to be relevant to good health—social support, healthy behaviors, and stress management. For men of this cohort, for whom work and achievement were often paramount societal goals, the picture is more complex; relations among personality, components of well-being, and longevity appear to depend on additional aspects of the psychosocial pathways.

When researchers are doing analyses derived in part from archival data, certain limitations are inevitable. When data were collected at each time point, the measures were not designed to answer our specific questions; therefore, items must be combined and refined to create a measure from the questions that were asked (Martin & Friedman, 2000). This limits how well the results can be generalized to modern-day samples. However, likely associations and pathways can be identified, and these can then be explored in subsequent studies with new samples. The findings of this study should not be directly generalized to other groups where other sociocultural variables are relevant. The Terman participants were intelligent, generally came from a middle-class socioeconomic background, and were ethnically homogenous (mostly White). Although this homogeneity limits the generalizability of the results, it also presents some benefits. Comparisons can be made within the group without being confounded by characteristics such as lack of access to health care,

inability to understand medical advice, or lack of opportunity for community involvement and physical activity. Previous studies using this sample have found a normal range of psychosocial characteristics (Friedman et al., 1995; Schwartz et al., 1995) and have found significant predictors of mortality that have been replicated in other studies (Goodwin & Friedman, 2006; Kern & Friedman, 2008). Caution is imperative in generalizing from any sample, especially when cohort-specific effects and method-related differences may affect the relationships involved. We have also noted that the 1986 cohort is a select group of people that survived to later life. However, the present study offers one way to conceptualize healthy aging and suggests some relations that now can be examined in other samples.

To the extent that personality is associated with various health outcomes, we can also learn something about the nature of personality. Most obviously, when personality predicts health and longevity, personality clearly has some reliability, validity, and real-world importance (Caspi et al., 2005; Ozer & Benet-Martinez, 2006; Roberts, Kuncel, Shiner, Caspi, & Goldberg, 2007). Especially relevant to the current study, the associations of different personality traits to different health outcomes over many decades may reveal new insights into personality itself. The current findings tend to support the validity of the identified constructs, showing a role for conscientiousness, agreeableness, extraversion, and neuroticism across the life span. This offers a base for future studies considering both predictors and outcomes of healthy aging as a multicomponent construct.

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## APPENDIX: INITIAL CATEGORICAL DEFINITIONS

*Physical health* refers to a person's physical well-being in a medical sense. Good physical health involves not being sick (as a physician would diagnose); poor physical health includes being sick or not functioning well physically. The

physical health category includes both these good and bad elements of health.

*Mental health* refers to the psychological aspects of a person, such as a person's mental adjustment. The presence of mental illness (such as depression, chronic anxiety, or more severe mental diseases) would indicate a low level of mental health.

*Cognitive functioning* refers to how well a person can think or how alert the person is mentally. It involves verbal abilities, reasoning skills, and good memory on the positive side. On the negative side, it includes mental decline, such as occurs with dementia or Alzheimer's disease. The cognitive ability category includes activities (like working at a mentally demanding job) that indicate high cognitive functioning or indicators of cognitive decline (like being confused or forgetful).

*Life satisfaction* refers to well-being from a subjective perspective (what I see as satisfying may be different than what you see as satisfying). It includes positive emotion and an overall global assessment of a person's life. It may include having a sense of purpose, accepting oneself, personal growth, and feeling in control of life. The life satisfaction category includes both satisfaction and subjective well-being on the positive side and dissatisfaction or lack of subjective well-being on the negative side.

*Social competence* refers to how well a person interacts with others. It includes the existence of social support networks (friends and contacts), interactions with friends and family, and overall satisfaction with interactions and the support given by others. A highly socially competent person is someone who is social, gets along well with others, and enjoys such interactions. A person with low social competence may have trouble relating to others. The social competence category includes both these positive and negative elements of social interactions.

*Autonomy* refers to personal control—how much people feel that they control their own lives. Highly autonomous people may feel that what happens in their lives is a result of their own actions, they choose what they do, and live independently. People low in autonomy may feel that events are out of their control or they are very dependent on other people.

*Productivity* refers to what a person is able to accomplish.

A productive person may be involved in work or volunteer activities, helps family members, has some concrete goals, and is motivated to accomplish things. The productivity category includes activities and ideas that make a person productive as well as indicators that would define a person as unproductive.

*Coping resources and styles* refers to how a person deals with stress that may occur during life. There are different types of coping styles; for example, if people start to forget things, they may ignore the problem (denial), they may write things down more and use mnemonic devices to help (an active coping style), or they may rely on a spouse or friend to deal with problems (seeking out others as a coping resource). The coping abilities category refers to positive and negative coping resources and styles.

