# Health Psychology

Margaret L. Kern and Howard S. Friedman

The Oxford Handbook of the Five Factor Model of Personality
*Edited by Thomas A. Widiger*

Subject: Psychology, Personality and Social Psychology, Health Psychology,
Online Publication Date: Jan 2016
DOI: 10.1093/oxfordhb/9780199352487.013.2

## Abstract and Keywords

As research on personality and health has moved to developing multitrait, multioutcome models, the five-factor approach has shown excellent utility for understanding health, including physical and mental health, longevity, cognitive function, social competence, and productivity. Drawing on a growing arsenal of advanced statistical techniques, studies are testing complex models to explain how personality influences health. Health behaviors, social situations, physiological changes, and various indirect and moderating factors are important pathways connecting personality and health, and reciprocally influence one another. Future personality research will benefit from interdisciplinary approaches, including integrative data analyses of archival data, big data analyses, neuroscientific approaches, and lifespan epidemiology. Bringing together different types of data, innovative methods, and well-specified theories offers the potential to understand the personality–health model in ways never before imagined. Identifying pathways and key factors in turn will inform effective intervention to help more people live healthier, more productive lives.

Keywords: health outcomes, longitudinal research, lifespan pathways, conscientiousness, disease-prone personality, self-healing, longevity

### Introduction

People have long dreamed of the fountain of youth. Young people believe they will live forever, scorning the wrinkles and pains of elders. People may have surgeries, wear makeup, run marathons, swallow supplements, and color their hair to make themselves look and feel younger. Older individuals fear the decline that often surrounds getting older, facing changes in their bodies and social circles, hoping to somehow be a healthy ager. Health psychology reveals that there are indeed paths to healthier aging. Some individuals thrive, but there is no simple route to a happy, healthy old age. Health unfolds over time, and individual histories, characteristics, and habitual patterns influence the processes and outcomes that occur. Research over the past three decades has discovered key reasons why personality is highly relevant to health.

Many factors are associated with health—but these correlations yield different advice about which patterns are healthy and which are unhealthy. It is impossible to randomly assign individuals to differing biopsychosocial life patterns, and so even many of the best studies on health involve disparate snapshots in time. Longitudinal studies provide the best windows into personality and health relationships. Dr. George Vaillant, after studying a group of Harvard men for over 40 years, noted: “No single interview, no single questionnaire, is ever adequate to reveal the complete man, but the mosaic of interviews produced by many observers over many years can be most revealing” (Vaillant, 2012, p. 95). That is, when multiple images are brought together, a clearer picture appears. In health psychology, a panoramic portrait that has emerged over the past few decades from many snapshots is the importance of the Big Five factors for health outcomes.

In this article, we first briefly examine the historical roots of personality and health psychology. Personality became an important part of the field during a time when the concept of personality itself was questioned. The Five-Factor Model

(FFM) became an organizing model, providing a structure for understanding personality and health associations. Second, we review a growing body of literature relating the five factors to health outcomes, ranging from subjective perspectives to mortality. Of the five factors, considerable evidence suggests that Conscientiousness is particularly important for health (see also the chapter by Jackson and Roberts). Third, we examine how and why personality might relate to health outcomes, beginning with simple models, and turning to a new era of sophisticated models. Fourth, growing numbers of tools and strategies are now available that can be used to address the complex issues that personality and health raise. Finally, we examine the implications and applications of the FFM for health psychology.

### Historical Perspectives

Links between personality and health have been noted for thousands of years. In the ancient Greek era, health was seen as the balance of four humors. It was generally believed that excessive black bile (melancholy) caused depression, cancer, and degenerative diseases, yellow bile (choler) caused hostility and fevers, phlegm (apathy) caused rheumatism, and balanced blood (sanguine) reflected the healthy individual (Friedman, 2007). To Plato, it was not only the well-balanced body, but also the balanced soul and mind. These dispositions interacted with behaviors and life circumstances to either maintain a healthy balance or cause mental and physical problems. Cures aimed at restoring bodily imbalances.

Such notions of the influence of character on physical health persisted in various incarnations for the next two millennia. In the mid-twentieth century, personality characteristics and physical illness and disability were again linked together. Specific traits were believed to cause specific illnesses. A major emphasis was on the Type A behavior pattern, a composite of traits such as tension, hostility, aggression, hurrying, and competitiveness, which was seen as a primary risk factor for coronary heart disease. But in 1987, Friedman and Booth-Kewley conducted a meta-analysis and found evidence of a general "disease-prone personality," rather than specific traits causing specific diseases. The findings challenged the field to simultaneously consider multiple traits or characteristics, as well as multiple health outcomes.

### The Five Factors and Health Outcomes

Although early health psychology research focused on Type A behavior and related domains of hostility, over the past two decades the FFM has become the dominant organizing framework for integrating studies of personality and health (Smith & Williams, 1992). A large and growing number of articles have examined links between the five factors (or related traits) and various health outcomes. Generally speaking, the five factors have been related to consequential life outcomes at the intrapersonal, interpersonal, and community level, including physical, mental, and social well-being; relationships with peers, family, teachers, employers, and romantic partners; job performance; political attitudes; crime; and community involvement; with effect sizes equal to or greater than socioeconomic status and cognitive ability (Heckman, Stixrud, & Urzua, 2006; Ozer & Benet-Martínez, 2006; Roberts, Kuncel, Shiner, Caspi, & Goldberg, 2007).

Personality research in health psychology has used a variety of health metrics, ranging from self-reported health to mortality. In 1948, the World Health Organization defined *health* as "physical, mental, and social wellbeing, not simply the absence of disease." Yet there are considerable inconsistencies in how the term is used, including discrepancies between lay and scientific definitions, disagreements within and across fields, whether health is seen as a process or an outcome, multidimensionality, and poor measurement.

Here, we define health as an outcome, personality as an independent variable, and other factors as mediators, moderators, or confounding variables. Studies (including our own) suggest five to eight meaningful health outcomes: self-rated health, physical (medical) health, longevity, mental health and subjective well-being, cognitive function, social competence, and productive function (Aldwin, Spiro, & Park, 2006; Baltes & Baltes, 1990; Friedman & Kern, 2014). From a biopsychosocial perspective, the successful life minimizes morbidity until the final year or so, thus encouraging thriving and accomplishment, while placing the least social and economic strain on the system (Fries, 1990).

## Physical (Biological or Medical) Health

Physical health is perhaps the most common use for the term "health." Physical health involves physiological function, organic disease, and energy for completing daily tasks. On the negative side, it is defined by physician-diagnosed disease, disability, inability to complete daily activities of living, and failure to thrive. What health means in the absence of disease is not well understood. Some evidence suggests that health is marked by balance across physiological systems, harkening

back to notions of humoral balance. For example, high blood pressure is associated with various diseases and thus is considered a marker of poor health, but low blood pressure can also indicate disease or physiological dysfunction. Similarly, a normal body weight is protective; disease is associated with too much weight (obesity) and too little weight (frailty, anorexia). However, deviations in blood pressure, weight, and other classic diagnostic tools of the medical examination may turn out to be healthy when other variables and circumstances are taken into consideration. In psychology, this balance idea has been extended to what Friedman (1991) termed the *self-healing personality*, but the phenomenon turns out to be a complex one.

Some studies have focused on biomarkers, which we define as processes, not final outcomes. Often, suspected biomarkers are not the causal links that they initially appear to be (Friedman & Kern, 2014). It is more important to focus directly on morbidity, illness, and physical functioning. Most consistently, Conscientiousness has been related to better physical health outcomes and Neuroticism has been related to poorer physical health outcomes. For example, in a longitudinal study with elderly patients, higher levels of Neuroticism and lower levels of Conscientiousness were associated with greater physician-rated illness across a 4-year period (Chapman, Roberts, Lyness, & Duberstein, 2013). In a twin study with young adults, participants high in Neuroticism at baseline were more likely to report 13 different physical health conditions 25 years later, including chronic fatigue syndrome, ulcers, and coronary heart disease (Charles, Kato, Gatz, & Pedersen, 2008). In a panel study with nearly 7,000 British adults, child intelligence related to better health status at age 50 years, but this association was mediated by Emotional Stability and Conscientiousness (Cheng & Furnham, 2013). In a nationally representative sample of U.S. adults, Conscientiousness was associated with a significantly reduced likelihood of a wide range of mental and physical disorders among adults in the general population, and Neuroticism was associated with increased rates, ranging from stroke to sciatica, with other five-factor traits also sometimes relevant (Goodwin & Friedman, 2006).

## Self-Rated Health

Self-rated health is a component of subjective well-being, although it is often mistakenly treated as an objective physical health marker. Questions assessing self-rated health are typically face valid and easy to use (e.g., an item might ask "In general, how is your health"). Notably, self-rated health is a good predictor of mortality risk (Idler & Kasl, 1991), but this does not mean that it can be used as a proxy for objective physical health (Friedman & Kern, 2014); age, sex, socioeconomic status (SES) and certain personality traits are also good predictors of mortality risk and are obviously not substitutes for assessing physical health.

Neuroticism has consistently been linked to lower self-rated health (see also the chapter by Tackett and Lahey). It is unclear how much of this is a real association and how much is due to self-selection or measurement biases. Both stress and self-reported health scales often contain a large negative affect component, creating noisy measures (Costa & McCrae, 1987; Watson & Pennebaker, 1989). People high in Neuroticism feel more pain, report more illness, and seek more care. It is an open question as to whether Neuroticism is indeed related to worse health, or if links are superficially created through poor measurement.

The other four personality factors appear to be less susceptible to this measurement problem, although the subjective nature of the self-report assessment remains. Conscientiousness has been robustly related to better self-rated health, predicting better reports both cross-sectionally and longitudinally, with effects sizes higher than intelligence and socioeconomic status (SES) (e.g., Hampson, Goldberg, Vogt, & Dubanoski, 2006; Roberts et al., 2007; Tam & Wi, 2014). A recent large-scale Internet study with over 450,000 people worldwide sponsored by the British Broadcasting Corporation found that low Conscientiousness related to lower reports of self-rated health, being overweight, and engaging in substance use; Neuroticism was related to lower self-reported health, and high Extraversion was related to more frequent substance use (Atherton, Robins, Rentfrow, & Lamb, 2014). Notably, for self-rated health, when items referring to stress and emotional problems were removed, associations with Neuroticism were much weaker, pointing back to the problem of overlapping predictors and outcomes.

## Longevity

Length of life is the clearest measure of health, as it is valid and reliable, and has consistently been used as a key measure of health worldwide (Friedman & Kern, 2014). The best longevity studies require longitudinal analyses that track people over many years or a lifetime, providing a more complete picture of the trajectories that the sample followed. Over the past two decades, there has been considerable work in personality–health research focused on links between

personality and all-cause mortality. Some studies have also considered other causes of death such as heart disease and cancer mortality. A problem with single cause of death analyses is that they can superficially provide "good" short-term results but "poor" long-term results; if a person is saved from cancer but dies from heart disease (such that the overall length of life is the same), then it is not a particularly successful treatment.

Early work focused on Neuroticism/negative affectivity as a primary cause of early death, but Neuroticism has been inconsistently linked to mortality. Studies find no association with mortality (e.g., Almada et al., 1991; Iwasa et al., 2008; Taylor et al., 2009), a negative association (e.g., Korten et al., 1999; Taga, Friedman, & Martin, 2009; Weiss & Costa, 2005), and a positive association (e.g., Christensen et al., 2002; Denollet et al., 1996; Shipley et al., 2007; Weiss, Gale, Batty, & Deary, 2009; Wilson, Mendes de Leon, Bienias, Evans, & Bennett, 2004). In the U.K. Health and Lifestyle Study, Neuroticism was related to higher risk, but was reduced to nonsignificance after controlling for SES, education, smoking, alcohol use, physical activity, and self-rated health (Shipley et al., 2007). It may be that some aspects of Neuroticism are protective and others are harmful (Chapman, Roberts, Duberstein, 2011), or it may depend upon interactions with other personality traits or the social environment (Smith, Baron, & Grover, 2014). A more complex approach is needed.

The strongest, most consistent findings for personality and longevity have appeared for Conscientiousness, with higher levels associated with lower mortality risk (Bogg & Roberts, 2013; Chapman et al., 2011; Friedman et al., 1993; Kern & Friedman, 2008; Roberts, Lejuez, Krueger, Richards, & Hill, 2014). A meta-analysis of 20 studies with diverse samples found that high levels of Conscientiousness are robustly predictive of lower risk (Kern & Friedman, 2008). Subsequent studies have consistently confirmed this finding (e.g., Iwasa et al., 2008; Taylor et al., 2009; Terracciano et al., 2008). Research has now shifted from establishing that the Conscientiousness -longevity association exists to explaining possible pathways and mechanisms.

Agreeableness has received less attention than the other five factors, and associations have been mixed, with many studies finding null results (e.g., Christensen et al., 2002; Iwasa et al., 2008; Taylor et al., 2009). Most clearly, hostility and cynicism (i.e., low Agreeableness) have been linked to heart disease mortality and all-cause mortality (Almada et al., 1991; Bunde & Suls, 2006; Chapman et al., 2011). Extraversion generally has not been associated with mortality risk, most likely because it depends on the pathways involved. That is, Extraversion is associated with both healthy patterns (e.g., sociability) and unhealthy patterns (e.g., smoking, drinking, thrill-seeking).

Openness to experience has also demonstrated mixed associations with longevity, although a recent meta-analysis with nearly 20,000 people suggested that it is protective, but its effect is attenuated by other risk factors (e.g., age, social class) (Ferguson & Bibby, 2012). The extent to which openness matters beyond SES, education, or intelligence is unclear.

## Mental Health and Well-Being

Subjective well-being (SWB) is inherently subjective, and includes emotion, self-rated health, cognitive evaluation of life, and other related components. Diener (2012) defines subjective well-being in terms of affect (high positive affect, low negative affect) and cognition (life satisfaction). Others have suggested multidimensional approaches to well-being. For example, Ryff and Keyes (1995) define well-being in terms of six components: autonomy, environmental mastery, personal growth, positive relationships, purpose in life, and self-acceptance. Seligman (2011) defined five pillars of well-being: positive emotion, engagement, relationships, meaning, and accomplishment. Huppert and So (2013) suggested 10 domains of the flourishing life contrasted against depression and anxiety: competence, emotional stability, engagement, meaning, optimism, positive emotion, positive relationships, resilience, self-esteem, and vitality. Across these different definitions, there appear to be two main components: hedonic well-being, referring to the emotional side, and eudaimonic well-being, or the good life (Ryan & Deci, 2001). Life satisfaction possibly represents a third, cognitive component.

A recent meta-analysis found that when properly controlled in a multivariate approach, personality can explain anywhere between 39% and 63% of the variance in well-being (i.e., happiness, life satisfaction, positive and negative affect, and quality of life) based upon NEO measures (Steel et al., 2008). Neuroticism and Extraversion consistently related to lower and higher well-being, respectively, with moderate to large effect sizes. Conscientiousness was moderately associated with well-being, with the strongest associations for quality of life. Agreeableness effects were low to moderate, and Openness was only weakly related to well-being.

Steel and colleagues (2008) suggested four reasons why personality and SWB should be correlated (see also Caspi et al., 2014). First, a growing number of theories and research point to biological elements (such as serotonin, dopamine, and some genes) that influence both how traits are manifested and proneness toward mental health or illness. Second, there is conceptual and measurement confusion. For example, an item on the mental health component of the Short Form-36 (Ware, Kosinski, & Keller, 1994) is "How much of the time during the past 4 weeks have you felt downhearted and blue," and an item assessing Neuroticism is "Often feel blue" (www.ipip.org). Not surprisingly, the two measures are correlated. Third, happiness levels tend to have a relative set point (Lyubomirsky, Sheldon, & Schkade, 2005). Correlations between well-being and personality measures will increase to the extent that well-being measures capture stable characteristics of the person rather than momentary states. Finally, personality influences the situations that people select and are drawn toward, and these situations have a strong influence on attitudes and emotions (Friedman, 2000).

## Cognitive Function

The cognitive aspect of health includes mental processes such as memory, perception, language, reasoning, decision making, and spatial ability. Numerous tests have been developed, ranging from brief mental screenings to complex cognitive batteries that capture both function and timing of declines. At the negative extreme is dementia and Alzheimer's disease, in which almost all cognitive function is gone. Although it is commonly assumed (and perhaps feared) that cognitive ability decreases over time, studies suggest that although fluid intelligence (e.g., memory capacity, speed of processing) decreases, crystallized intelligence (e.g., cultural knowledge) generally remains fairly stable (Staudinger, Cornelius, & Baltes, 1989). There is also considerable variation; some individuals can maintain very effective cognitive performance even in old age (Reynolds et al., 2005; Richardson, 2005).

Studies are increasingly linking personality to cognitive function. Across a 6-year period, risk for Alzheimer's disease was associated with high levels of Neuroticism, low Openness, and low Conscientiousness (Duberstein et al., 2011). In the Lothian Birth Cohort, low Conscientiousness related to greater loss of brain tissue and hyperintensities of white matter, with effects partially mediated by health behaviors (Booth et al., 2014). A meta-analysis of 15 studies found that high Neuroticism was associated with higher risk for dementia, Conscientiousness was protective, and Openness, Extraversion, and Agreeableness were not reliably related (Low, Harrison, & Lackersteen, 2013). Findings again point to the cumulative physiological effects that Conscientiousness and Neuroticism seemingly have over the life course.

## Social Competence and Productive Function

Social competence and productive function are two final health outcomes that are valuable both for individuals and for society as a whole. Consistent with the World Health Organization definition of health (described above), the well-being of the individual and the well-being of society ought to be mutually reinforcing. Social competence refers to being able to develop and maintain positive social relationships with others. It is separate from social support—a contextual variable that can influence social relationships, but is not the same as how good those relationships are. It has become clear over the past decade that social relationships are very important in the thriving life (Tay, Tan, Diener, & Gonzalez, 2012; Taylor, 2011).

Whether in paid work or social/civic engagement, productivity allows society to function smoothly. Engaging in work and having a sense of productivity contributes to better life quality (Bambrick & Bonder, 2005). In his presidential address to the American Psychological Association, Robert Kaplan (1994) brought to light the importance of productive engagement. In a Ziggy cartoon, Ziggy asks the wise sage what the meaning of life is, and is told "life is doin' stuff … as opposed to death, which is not doing stuff" (p. 452).

Perhaps the clearest markers of social competence and productivity are successful marriage (versus divorce or isolation) and educational/occupational attainment (versus unemployment or idleness), respectively. Neuroticism predicts divorce, and high Agreeableness and Conscientiousness are related to more stable and better marriages and less divorce (Roberts et al., 2007). In the lifespan Terman sample, across a 40-year period, Extraversion, Agreeableness, and Conscientiousness predicted greater social competence, and Conscientiousness predicted greater productivity (Friedman, Kern, & Reynolds, 2010). Agreeableness is particularly important for maintaining harmonious relationships with other people (Jensen-Campbell, Knack, & Gomez, 2010; see also the chapter by Graziano and Tobin). Each of the Big Five traits has been related to educational and occupational attainment, with Extraversion, Agreeableness, Conscientiousness, intellect, and low Neuroticism related to greater achievement and more stable employment (Roberts et al., 2007).

**Linking Personality and Health**

Now that we know that personality matters to health, the interesting question quickly becomes: *How and why does it matter?* Theories and studies are now breaking open the black box to expose the complex underpinnings of how personality affects health and how health affects personality.

## Mechanisms and Moderators

Various pathways have been proposed to link personality and health outcomes (Chapman, Hampson, & Clarkin, 2014; Hampson, 2008; Kern & Friedman, 2010; Smith, 2006). Pathways include health behaviors, social situations, physiological changes, and indirect and moderating factors.

### Health behaviors.

The clearest pathway linking personality and health is through the behaviors in which people do and do not engage. Across 194 studies, Conscientiousness-related traits were positively related to health protective behaviors and negatively related to risky behaviors (Bogg & Roberts, 2004). In the Midlife in the United States (MIDUS) study, Conscientiousness and health links were substantially mediated by excessive alcohol use, smoking, and waist circumference (Turiano, Chapman, Gruenewald, & Mroczek, 2015). Conscientious individuals are more likely to adhere to medical advice, with physical health consequences (Hill & Roberts, 2011; O'Cleirigh, Ironson, Weiss, & Costa, 2007). Smoking explains part of the Neuroticism–mortality association (Mroczek, Spiro, & Turiano, 2009; Shipley et al., 2007). Extraversion, Agreeableness, and Openness have been inconsistently linked to risky and healthy behaviors.

Although numerous studies find that behaviors mediate the personality–mortality link, considerable variance consistently remains, suggesting that other pathways also matter. For example, in the Whitehall II cohort study, associations between Conscientiousness and mortality were attenuated only 13% when health behaviors were controlled (Hagger-Johnson et al., 2012). Adding in SES, physiological risk factors, and minor psychiatric morbidity further attenuated associations by 16%. Studies using structural equation modeling suggest that both health behaviors and education mediate Conscientiousness and health associations (Kern, Hampson, Goldberg, & Friedman, 2014; Lodi-Smith et al., 2010), but that is only the beginning.

Alternative study designs that unearth how personality plays out in daily life may be informative. For example, a 28-day study found that Conscientiousness related to less consumption of high fat snacks, but also higher caffeine intake and more smoking among those who did smoke (O'Connor, Conner, Jones, McMillan, & Ferguson, 2009). At the facet level, participants high in *order* did more exercise on stressful days, *self-efficacy* related to eating vegetables, and smokers high in *self-discipline* smoked more on stressful days, pointing to interactions between daily stress and health behaviors. Other studies similarly suggest that the facet level may be more predictive of behaviors than the five factors alone (Kern et al., 2013; Paunonen, 1998; Paunonen & Ashton, 2001).

### Social pathways.

A second set of important pathways connecting personality and health is through social influences—situation selection, aspects of the social context, and interactions with other people, all of which influence and affect personality and health. Personality draws people toward certain situations, which become self-reinforcing over time (Friedman, 2000). For example, high Extraversion is related to experiencing more positive life events (both subjectively and objectively rated), whereas Neuroticism relates to experiencing more negative life events (Magnus, Diener, Fujita, & Pavot, 1993). Events and experiences in turn impact self-perceptions.

Self-regulation, social responsibility, Agreeableness, and emotional stability may help set the stage for better interpersonal relationships. In a group of adolescents, high Conscientiousness related to better friendships, higher peer acceptance, and less victimization, with associations mediated by externalizing behaviors (Jensen-Campbell & Malcolm, 2007). In the Mills Longitudinal Study of Women, social responsibility predicted family, work, and behavioral outcomes 20 to 30 years later, and marital quality, work behaviors, and substance use were associated with subsequent changes in social responsibility (Roberts & Bogg, 2004). A meta-analysis of 94 studies found that high Agreeableness, emotional stability, and Conscientiousness related to greater investment in work, family, religion, and volunteering social roles (Lodi-

Smith & Roberts, 2007). Notably, the personality of others can also impact health; a spouse with high levels of Conscientiousness predicted better physical health outcomes, over and above the impact of the person's own personality (Karademas, & Tsaousis, 2014; Roberts, Smith, Jackson, & Edmonds, 2009). The company that we keep matters for both who we are as people (our personality) and for subsequent life outcomes.

### Physiological pathways.

As tools and methods have improved, considerable research is now turning toward internal mechanisms, attempting to untangle how personality affects physiological function, with possible health consequences. In a sample of healthy adults, participants scoring low on Agreeableness and Extraversion demonstrated increased sympathetic nervous system activity and, for Extraversion, higher natural killer cell cytotoxicity, suggesting that personality is associated with basal physiological levels (Miller et al., 1999). In adults from Sardinia, high Neuroticism and low Conscientiousness were associated with higher levels of interleukin-6 (Sutin, Terracciano, Deiana, Naitza, et al., 2010), and low Conscientiousness was related to lower high-density lipoprotein (HDL) cholesterol and higher triglycerides (Sutin, Terracciano, Deiana, Uda, et al., 2010). Serotonin has been linked to impulsivity (low Conscientiousness) and hostility (low Agreeableness) (Carver & Miller, 2006).

Much of the work on physiological pathways has stemmed from a general focus on the deleterious effects of stress. According to the basic stress model, high levels of stressors can trigger a state of homeostatic disruption in which the heart beats faster, breathing speeds up, cortisol and catecholamine levels increase, inflammation increases, and immune function is depressed (Kemeny, 2007; McEwen, 2006). Although in the short term, this reaction may be adaptive, in the long term, a chronic negative response pattern becomes detrimental, disrupting metabolism, immune function, and physiological rhythms, and increasing susceptibility to illness, disease, and general breakdown. Illness in turn further affects psychological functioning, creating a negative cycle toward disease.

Personality seemingly impacts what stressful events are encountered, the extent to which stressors are considered stressful, and coping responses (Carver & Connor-Smith, 2010; Connor-Smith & Flachsbart, 2007; Segerstrom & O'Connor 2012). Neuroticism is consistently viewed as the trait that increases the risk for maladaptive responses, chronic stress, and poor health outcomes. For example, in one study, blood pressure in women high in Neuroticism showed less recovery after a hostile interaction than after a friendly interaction (Hutchinson & Ruiz, 2011). In a second study, Neuroticism was related to higher daily cortisol measures across a 6-day period (Nater, Hoppmann, & Klumb, 2010). Across a 10-year period, hostility was related to less healthy diastolic blood pressure, although effects varied by gender (Leclerc, Rahn, & Linden, 2006; see also Smith, Glazer, Ruiz, & Gallo, 2004; Williams & Williams, 2012). Positive traits may buffer the physiological system from stress reactions or quickly restore balance to the system when stress occurs (Fredrickson, 2001; Pressman & Cohen, 2005).

Studies addressing this model typically measure personality concurrently with physiological markers, such as blood pressure, immune and endocrine function, or cardiovascular reactivity. An assumption of this model is that cross-sectional and short-term associations between personality and physiological function will extend to disease outcomes later in life. However, studies are only beginning to test the process longitudinally, and almost no studies have examined early life personality, prolonged stress exposure, long-term physiological disruption, and subsequent disease, at least in the same individuals. In one of the first long-term tests of the physiological pathway, in the Hawaii Personality and Health study, low childhood Conscientiousness was related to physiological dysregulation, greater obesity, and worse lipid profiles 40 years later (Hampson, Edmonds, Goldberg, Dubanoski, & Hillier, 2013). Personality may affect the immune system, and the immune system may impact personality, such that causal arrows are nonexistent (Kemeny, 2007). Longitudinal studies across long life periods, which include personality, physiological markers and stress measures across multiple time points, and health outcomes are necessary to truly establish the physiological pathway.

### Third variables.

Another way that personality and health can be connected is through third or confounding variables—factors that relate independently to personality and health, such that the two appear to be related, when it is really another factor that drives both relationships. The most notable third factor is genetic influences, although a host of other factors are potential confounders as well. Personality has both genetic and environmental influences (Jang, Livesley, Angleitner, Riemann, & Vernon, 2002; South & Krueger, 2014), and some of these same influences also impact health outcomes. Genetic studies could reveal biological systems underlying trait and health differences, and may moderate how traits are

manifested across the lifespan (South & Krueger, 2014). Some traits may turn on or off at different points in life, with health-related implications. Much of the work with genetics and personality shows promise, but the data are messy. As methods are continually refined, genetic studies will continue to play an important role in the future, but genetics have often been found to have relatively little predictive value unless environmental influences are simultaneously considered.

Similarly, the enduring social context, including SES and risky environments, influences both personality and health. For example, in MIDUS, personality explained about 20% of the SES gradient in mortality risk, and SES explained 8% of personality risk (Chapman, Fiscella, Kawachi, & Duberstein, 2010), such that some of the health risk comes from the environment, part is due to individual dispositions, and part may be the interaction of the person and environment. Early environments may also promote particular traits and set various health trajectories. For example, secure attachment has been linked to optimal self-regulations in childhood and adolescence (Eisenberg, Duckworth, Spinrad, & Valiente, 2014). More complex models are needed, which consider how personality and social contexts interact to influence health outcomes across the lifespan.

### Moderators.

Finally, personality can also moderate and be moderated by other variables. In the Terman Life Cycle Study, Conscientiousness moderated the relationship between career success and mortality, such that Conscientiousness buffered the otherwise risky effects of career failure (Kern et al., 2009). In the German Socio-Economic Panel Study, Agreeableness moderated adaptation to disability, such that those high in Agreeableness regained general life satisfaction several years later, whereas disagreeable individuals did not (Boyce & Wood, 2011). In another sample, Openness, Extraversion, and Neuroticism moderated associations between stress and health behaviors (Korotkov, 2008). In a French sample, although Neuroticism related to worse physical functioning, this effect was amplified at low levels of education and diminished at high levels of education (Jaconelli, Stephan, Canada, & Chapman, 2013). In a group of children and adolescents, associations between prosocial behavior, externalizing problems, internalizing problems, and grades were moderated by the early family environment, with effects being stronger in more difficult circumstances (Slobodskaya, Ashmetova, & Rippinen, 2014).

### Summary.

By peering into the black box, we have identified multiple pathways that connect personality and health, which are often studied separately. The clearest and perhaps most straightforward pathway is health behaviors. Interventions need to be sensitive to personality dispositions, and by changing one's behaviors, risky characteristics may potentially shift to healthier ones (Chapman et al., 2014). However, the social context (especially relationships with other people and socioeconomic status), biological factors, and various environmental factors selected by and shaping personality are also very important, and may impact both behaviors and health outcomes. Personality shapes how a person experiences, interprets, and responds to events throughout the lifespan (Caspi, Roberts, & Shiner, 2005). It can moderate pathways and reactions, and effects can be bidirectional, synergetic, and cumulative. To truly understand the web of influences, models that simultaneously bring together multiple pathways are needed.

## A New Generation of Personality–Health Research

Friedman and colleagues (2014) introduced a new generation of personality and health models, characterized by complex, dynamic, lifespan models. Rather than separating out the pathways reviewed above, third generation models recognize that all of these pathways matter, and most likely reciprocally influence one another. An analogy for this new generation of models is a ship traveling on a journey. As the journey begins, its course is set by the captain. The shape and depth of the water determine how big the ship can be and how fast it can travel, just as genetic and environmental factors set boundaries for development. Personality is the rudder, steering the boat through the waters. It sets a course, which can shift, but takes time and effort. Just as the pathway for the journey is unknown to the passengers, many of the early influences on personality may take time to appear. As river conditions and obstacles are encountered, the captain might adjust the rudder, shifting the course of the journey, just as health behaviors, social relationships, physiological responses, and health outcomes affect personality. Thus, it is the dynamic process of a relatively stable trajectory in the midst of an unsteady and changing context that results in health-promoting or risky life pathways. By understanding the range of influences involved, interventions can be done at the right time to avoid danger and to travel an optimal route.

New theories and models within this framework provide some guidance for beginning this new generation of studies. For

example, Smith and colleagues (2014) introduced the interpersonal perspective of personality, social, and clinical psychology in which psychosocial risk accumulates over long periods, resulting from dynamic interactions between individuals and their social contexts. Interpersonal experiences such as marriage can trigger physiological stress responses, which can result in cardiovascular disease or other health problems as stress becomes chronic. The overt experiences and covert behaviors reciprocally build either positive or negative patterns, which in turn affect cardiovascular reactivity, neuroendocrine responses, and other physiological components. Personality influences who ends up in different relationships, yet it is the resulting dynamic interaction patterns that have a stronger impact on chronic health risks. Eaton and colleagues (2012) proposed a framework aimed at the complex genetic and environmental influences on healthy aging. Rather than measuring health behaviors at a single period, behaviors should be measured as patterns over time (see also Friedman & Martin, 2011). They further suggest that approaches from behavioral genetics, such as co-twin controls and gene-by-environment analyses, can provide a structure for more sophisticated models and analyses.

Shanahan and colleagues (2014) recently proposed the Life Course of Personality (LCP) model, which proposes that different mechanisms matter to health at different phases across life, and are moderated by the social context and other aspects of the person. Associations may depend on the specific facet. For example, for Conscientiousness, facets such as deliberation, responsibility, self-discipline, and low impulsivity may decrease chronic stress, whereas facets such as achievement striving, orderliness, and perseverance may increase daily stress. Personality is embedded in the social context throughout development, beginning with an infant's temperament and early interactions with parents; behavioral and educational choices in adolescence; decisions about school, work, and life during the transition to adulthood; and behavioral, work, and family patterns that occur in adulthood. To study such a model, there is a strong need to establish large, diverse samples followed over extensive time periods, as well as specific, strategic samples to study more fine-grained time-limited processes.

Testing dynamic models will be a challenging endeavor, and personality–health researchers will benefit from staying current on the ever-developing statistical tools available, as well as working collaboratively with statisticians who develop new tools. Dynamic processes can be misconstrued with traditional statistical models. Data are needed that follow people prospectively over time, with repeated measures of personality, health behaviors, physiological functions, social relationships, contextual elements, and health measures. Research needs to be theory driven, yet still open enough for exploration, with empirical findings informing the theoretical models. Below, we review some of the innovative trends that will take personality–health research into the future. To truly have an impact on health, our models and methods need to move to a greater level of sophistication.

Drawing on a growing arsenal of advanced statistical techniques, studies are starting to test more dynamic models. For example, using structural equation modeling (SEM) to directly model lagged reciprocal effects, physical health influenced subsequent positive affect, whereas emotion did not affect subsequent physical health reports (Finch, Baranik, Liu, & West, 2012). Using SEM to capture multiple processes in the causal chain across a 25-year period, early adversity was related to more smoking and higher body mass 16 years later, which in turn were related to inflammatory markers measured 1 to 4 years later (Raposa et al., 2014). Combining SEM and survival analyses, Neuroticism was indirectly associated with mortality risk through somatic health, psychological distress, and smoking pathways, and Extraversion was indirectly associated with mortality through smoking (Ploubidis & Grundy, 2009).

Beyond single assessments of personality, health, and other variables, several studies have examined change over time. Across a 3-year period, latent change models indicated that changes in Conscientiousness were related to changes in health behaviors and self-perceived physical health (Takahashi, Edmonds, Jackson, & Roberts, 2013). In MIDUS, becoming less conscientious and becoming more neurotic over a 10-year period were related to worse perceived health and well-being, a greater presence of metabolic syndrome components, and a greater likelihood of diagnosis for metabolic syndrome at follow-up (Human et al., 2013), and changes in Conscientiousness were related to work limitations due to physical or mental reasons (Turiano et al., 2012). In an Australian study, increases in Conscientiousness and Extraversion were related to improved self-reported mental and physical health, and increases in Neuroticism related to worse self-reported health, but associations were moderated by birth cohort (Magee, Heaven, & Miller, 2013). In the VA Normative Aging Study, men with both a high average level of Neuroticism and increasing levels over time were at a higher mortality risk than those with lower levels or nonincreasing levels (Mroczek & Spiro, 2007). In the Lothian Birth Cohort of 1921, decreases in Conscientiousness across the ninth decade of life were associated with declining physical fitness (Mõttus, Johnson, Starr, & Deary, 2012).

**Tools for the Future of Personality and Health**

To overcome the flaws of studies based on self-reported data, future personality research will benefit from creative, interdisciplinary approaches. Numerous tools (e.g., innovative statistical approaches), data sources (e.g., behavioral observations, big data), and strategies (e.g., personality neuroscience, computational social science, animal comparisons) are increasingly available that will propel personality-health research into an exciting future.

## The Power of Existing Studies: Long Data

Two decades ago Jack Block (1993) suggested that to truly study personality, studies should be intentional, open, long enough to observe things, theory-based, broad and deep, methodologically sound and well-orchestrated, innovative, have a reasonable sample size, and maintain high quality over time. Fortunately, over the years, many studies have been conducted that meet many of these qualities. Much of our existing knowledge of life course personality–health associations stem from long data—extensive data gathered prospectively across time documenting people's lives. For example, much of the personality–health focus over the past decade has been on the importance of Conscientiousness for health outcomes. The Conscientiousness–longevity link was first uncovered in an exploration of data from the lifelong Terman Life Cycle Study (Friedman et al., 1993). Through over 40 years of working with the Harvard Grant Study, George Vaillant (2012) noted: "I've been studying adult development since I was thirty, and I know now that many of my past conjectures, apparently accurate at the time, were contingent or just plain wrong" (p. 1472). Only by looking at detailed information collected over many years can true relationships be fully revealed. "Long term longitudinal studies are like mature trees … like a century-old oak, such studies are rare resources and can add to our knowledge base in ways newer longitudinal studies cannot" (Mroczek, 2014, p. 1472). Fortunately, studies such as the Terman Life Cycle Study and the Harvard Grant Study are converging on similar conclusions (Friedman & Kern, 2014).

Through existing longitudinal studies, it is now possible to model more complex pathways, especially when multiple measurement occasions were included. For example, survival analyses estimate mortality risk across different ages, while accounting for attrition and for long-lived individuals who are still alive at the point of analysis. Growth curve analyses with two or more time points can estimate whether the sample as a whole is changing over time and the extent to which individuals vary from that overall trajectory. Both initial levels (scores at baseline) and slope (changes over time) can be related to other predictors and outcomes. Cross-lagged analyses start to untangle causal pathways (e.g., physical activity at time 1 affecting physical fitness at time 2 versus fitness affecting activity). SEM allows complex associations to be estimated, while directly including measurement error, direct and indirect pathways, mechanisms, moderators, control variables, and correlated error in the model. Growth mixture modeling identifies unobserved groups that change differently over time. An arsenal of modeling options is increasingly available.

Of course, longitudinal data are far from perfect (Tomlinson-Keasey, 1993). The original investigators usually were interested in different questions, scales are often nonexistent, and constructs are often represented by only one or two items. Data may be missing, although newer statistical techniques provide tools to deal with missing data problems. Attrition is a notorious challenge, and often those at highest health risk are those least likely to stay in the study. Studies were often done on select samples that may not generalize to other population groups (although this is often less of a problem than it first appears). Work with archival data needs to be driven by theory and specific research questions. It is a long process, involving developing an extensive knowledge of the data, carefully considering validity issues, and the possibility of recasting parts of the archive (i.e., restructuring existing data to create new measures of a construct) to address different questions (Elder, Pavalko, & Clipp, 1993). Yet existing studies offer a wealth of data, representing major investments by prior researchers, funding agencies, and participants, and it is well worth the effort to work with them and learn what we can from the data. By building on prior work, we can augment the field and science as a whole (Friedman et al., 2014).

## Integrative Data Analysis

Taking long data to the next level, the existence of many longitudinal datasets has brought the intriguing possibility of directly combining studies to study lifespan personality and health processes in greater detail. There are multiple ways that data can be integrated. A common method, and what many of the strongest findings in personality and health research are based on, is aggregated data meta-analysis, in which effect studies from multiple studies are combined, and moderators are examined. Meta-analyses have identified the clearest personality and health associations, but gloss over longitudinal trajectories and data needed to capture more complex trajectories. One of the greatest criticisms is that

meta-analysis can seem to combine apples and oranges; although both are types of fruit, results are more of a fruit salad than an apple pie.

Pooled integrative data analysis directly combines the data from multiple studies at an item level, rather than combining the average study effect sizes. Direct integration ensures that the same items or constructs are being assessed in each sample, rather than combining divergent constructs that are labeled as the same. Directly pooling data provides increased statistical power, the ability to study extended developmental periods, and direct tests of sample heterogeneity. One of the best examples of integrative studies in health psychology is the Integrative Analysis of Longitudinal Studies on Aging (IALSA) network, a collaboration of longitudinal studies on aging, health, and cognition (see http://www.ialsa.org). The group has pioneered methods to link psychological studies together at the item level (Bauer & Hussong, 2009; Curran & Hussong, 2009; Hofer & Piccinin, 2009, 2010).

Friedman and colleagues (2014) suggested that the same approach could be used to examine personality and health associations, integrating studies where possible to link two or more studies together, and then extending analyses to unique aspects of each study. For example, Kern and colleagues (2014) directly integrated data from the lifelong eight-decade Terman Life Cycle Study and the Hawaii Personality and Health Study. Items in each sample were aligned to the five factors. Then, using the pooled data, personality was tested as a predictor of self-rated health 40 years later. Conscientiousness predicted better self-rated health, directly and indirectly through educational attainment. The aligned personality factors were then used to test Conscientiousness as a predictor of longevity in the Terman sample and physiological regulation in the Hawaii sample, supporting pieces of the lifespan model. Unlike study level meta-analyses, this process ensures that the same constructs are being used as predictors. By testing well-defined lifespan theories with integrative data, it may be possible to empirically piece together the whole life course model.

## Ongoing and New Longitudinal Studies

As many of the longitudinal studies are still ongoing, there is an opportunity to add measures within the broader studies to test lifespan development. A particularly promising approach is the measurement burst design, in which intensive periods of measurements, such as daily diaries or experience sampling, are nested within long-term longitudinal studies (Nesselroade, 1991). The design allows direct consideration of intraindividual variation. With larger, nationally representative samples, participants from different age groups can be randomly selected for periods of short-term intensive measures, testing some of the more fine-grained mechanisms defined by the theoretical models.

New studies will add the most benefit to the field by carefully planning measures and strategies to test complex models. Cross-sectional studies that simply show that variables are related offer limited value; prospective studies are needed. To help manage the time burden for participants, growing numbers of computer-adapted tests (CATs) are available, such as the National Institute of Health's PROMIS (www.nihpromis.org). CATs include a large item bank, in which items are aligned across an underlying distribution for a given characteristic. Depending upon how a person answers a question, subsequent questions are pulled from different parts of the distribution, such that a reliable estimate of the person's true score can be determined with four to six questions. The most discriminating items might be compiled into a short form for off-line panel studies. Furthermore, planned missingness allows different subsets of participants to complete measures at each occasion, reducing the burden on participants, while increasing the number of constructs that can be measured.

## Behavioral Data

Beyond self-reported data, a growing body of research has focused on behavioral health and personality measures. For example, the self-control facet of Conscientiousness has been measured by delay of gratification tasks and various executive function tests (e.g., Stroop test, go/no-go task, trail making task, Balloon Analogue Risk Task). Convergence across self-report, observer report, delay of gratification measures, and executive function tasks is moderate, and studies may benefit from including both questionnaire and behavioral tasks to provide a more complete assessment of the person (Duckworth & Kern, 2011). Behavioral-based measures can also be used with young children who cannot read and answer questions and with lower SES or cognitively challenged participants who may have trouble understanding normal personality questions.

Using videotaped interviews, lay people could reliably rate 62 behaviors as diagnostic of the Big Five traits, suggesting that we often make personality judgments about others through the things that they do (Funder & Sneed, 1993). Gosling and colleagues (2002) found that personality is manifested in the surrounding environment. Observers who briefly saw a

person's bedroom or office made ratings of the person's personality; these moderately correlated with self-ratings and peer-ratings of the same person. Jackson and colleagues (2010) identified behavioral components of Conscientiousness and developed the Behavioral Indicators of Conscientiousness, which offers a way to assess what conscientious people do in their daily lives. Studying how positive personality traits are manifested in everyday life may inform interventions.

Taking this a step further, Mehl and Pennebaker (2003) developed the Electronically Activated Recorder (EAR), which captures 30-second sound bites throughout a person's day. Judges rated their impression of the person's personality using the recordings; their ratings were generally accurate, particularly for Extraversion, suggesting that natural observations offer a method to understand how personality is expressed in everyday behavior (Mehl, Gosling, & Pennebaker, 2006). Such unobtrusive measures might also point to the pathways toward health as social interactions, behaviors, and emotional reactions are captured in the moment throughout the day.

## Computational Social Science: Big Data Intrigues

Over the past decade, massive amounts of data, including online social media (e.g., Facebook, Twitter), electronic health records, online blogs, and search patterns, have been created, unobtrusively documenting peoples' lives (Anderson, Fagan, Woodnutt, & Chamorro-Premuzic, 2012). By combining tools from computer science, the massive amount of available data, and personality theory, health psychology researchers can and should take advantage of these rich data sources.


*Click to view larger*

*Figure 1.* Word clouds depicting 50 words/phrases that most strongly correlated with conscientiousness (left) and neuroticism (right) in 69,792 Facebook users. Larger words are more strongly correlated with the factor. Phrases (two- to three-word combinations) are indicated by an underscore.

(Adapted from Kern, Eichstaedt, Schwartz, Dziurzynski, et al., 2014.)

Using words expressed through online modalities, evidence suggests that personality is displayed and perceived through the language that people use in online and mobile environments (Gill, 2004). In nearly 70,000 Facebook users with 20 million status updates, personality scores were related to language use (Kern, Eichstaedt, Schwartz, Dziurzynski, et al., 2014). Figure 1 shows word clouds of 50 words and phrases (a series of two to three words, indicated by an underscore) that were most strongly correlated with Conscientiousness (left) and Neuroticism (right). The size of the word indicates how strongly the word or phrase is correlated with the trait (larger equals a stronger correlations). The method was also used to examine age-related differences (Kern, Eichstaedt, Schwartz, Park, et al., 2014). Although all analyses were cross-sectional (i.e., different people selected from each age group), as social media is used over time, it will become a tool to follow people's words, behaviors, and social interactions over the course of days, months, or even years.

Big data offer opportunities for identifying contextual aspects that may influence health outcomes. Personality research focuses primarily on the experience and perspective of individuals, and yet people exist within ecosystems. Many of the key sociocultural variables that moderate the life course models are either unmeasured in a particular sample or unidentified, and big data can identify these sociocultural factors. Key contributors can then be tested in smaller studies, comparing aspects of different communities, being cognizant of the individual and social personalities that appear.

For example, geo-tagged search queries from consented mobile phones predicted health care utilization and duration of hospital stays (Yang, White, & Horvitz, 2013). Monitoring search logs identified adverse drug reactions, and may serve as a complement to the Food and Drug Administration's adverse event reporting system, which relies on spontaneous reports of problematic reactions (White, Harpaz, Shah, DuMouchel, & Horvitz, 2014). With Twitter data, U.S. counties scoring high in self-reported life satisfaction expressed language reflecting productive engagement in life, physical activity, spirituality, and nature (Schwartz et al., 2013), and counties with high incidence of atherosclerotic heart disease expressed language reflecting hostility and apathy (Eichstaedt et al., 2015). The tweets may be reflecting aspects of the social or cultural context that may be more or less health promoting.

Data from online social media, mobile applications, and other technologies provide a new experiential sampling method

that documents people's everyday lives unobtrusively, with relatively low cost and resources. When combined with long data, there is the possibility for a new type of measurement burst design (Nesselroade, 1991), with questionnaire and physiological measures collected over many years complemented by bursts of daily patterns determined through online data sources. Interventions can be administered and tested remotely and adjusted to the person's responses. Altogether, combining long and big data offers the potential to study and understand the personality–health model in ways never before imagined.

## Personality Neuroscience

Personality neuroscience attempts to find markers of personality in the brain, and then to map those markers back to gene-by-environment interactions (DeYoung & Gray, 2009). Personality neuroscience attempts to determine why people differ from one another, identifying biological sources for differences between individuals (see also the chapter by Allen and DeYoung). Methods include neuroimaging, genomics, electrophysiological techniques, assays of psychoactive substances such as neurotransmitters, and direct changes through pharmaceuticals. For example, DeYoung and colleagues (2010) mapped neural images to the Big Five factors. Extraversion was related to the brain area that processes rewards, Neuroticism was related to the brain regions associated with negative affect and threat, Conscientiousness was related to the areas involved in planning and control of behavior, and Agreeableness was associated with areas involving understanding the intentions and motivations of other people. Similarly, the five factors correlated with different parts of the default mode network (a series of stable cortical brain areas thought to serve various cognitive and emotional functions), regions that have themselves been correlated with various response patterns for different emotional and cognitive stimuli (Sampaio, Soares, Countinho, Sousa, & Gonçalves, 2013).

Neuroscience approaches have been relatively neglected in most lifespan personality–health research, in large part because measures have not been available within existing studies. If neurological measures are embedded within larger lifespan studies, neural mechanisms underlying personality and health processes can potentially be identified. Physiological indicators might be reliably mapped to the five factors via a self-report measure, and then neurometric measures of personality could be developed, and the brain circuitry that plays a part in individual differences could be identified (Patrick, 2014). Combined with the network of complex models, personality neuroscience may help to further break open the black box, revealing minute processes that connect personality processes and subsequent health outcomes.

## Other Specie Parallels: Animal Studies

Another approach for studying personality and health involves utilizing nonhuman species (see also the chapter by Weiss and Gartner). Personality clearly appears in animals. For example, dog personality has been classified into dimensions such as reactivity, fearfulness, activity, sociability, responsiveness to training, submission, and aggression. A meta-analysis of 31 studies suggested moderate consistency in traits, with personality being more consistent in adult dogs than in puppies (Fratkin, Sinn, Patall, & Gosling, 2013), similar to the stability of personality in adulthood versus childhood in humans. Reflecting the hierarchical structure of the Big Five factors in humans (i.e., two higher order alpha and beta meta-factors, the five factors, and underlying aspects, facets, and specific traits), a study of chimpanzees found a similar hierarchical structure of personality, with two higher order alpha and beta factors hierarchically situated above a five-factor structure (Latzman, Hopkins, Keebaugh, & Young, 2014). In a study with seven different social groups of rhesus macaques, personality influenced who successfully intervened in group conflict as well as roles in grooming and network behavior (McCowan et al., 2011). By using a network analysis, the study identified interactive effects among personality, social status, and sex, which together influenced the stability of social groups.

Whereas human studies are almost exclusively correlational in nature, direct experiments can be done with animals, directly testing cause and effect associations (Cavigelli, 2005). Furthermore, the entire life course can be observed over a much shorter period of time. For example, studies suggest that physical activity extends longevity in animals, and both biological and nonbiological factors play a role (Sallis, 2000). Stress studies with animals suggest that persistent activation of the hypothalamic–pituitary–adrenal (HPA) axis can lead to permanent physiological damage (Repetti, Taylor, & Seeman, 2002). Animals can be bred with particular characteristics to test genetic versus environmental effects on physiological outcomes. Environments can be created to mirror different human conditions, testing the effects on physiological measures, length of life, and changes in brain structure. Altogether, evidence suggests that animals do indeed have personality characteristics relevant to the Big Five factors, and can be useful for studies on personality,

stress, immunity, and health (Mehta & Gosling, 2008).

**Application: Intervention**

The value of identifying pathways and influential factors lies in the potential to inform interventions that will help more people live happier, healthier, productive lives, with benefits to society through reduced economic costs and burden to the system. Currently, there is a large gap between personality research and the real world context of medicine and behaviors (Mermelstein & Revenson, 2013). The most successful theories will explicitly specify causal, direct, and indirect links, will be dynamic in nature and sensitive to context, will be consistent with real-world evidence, and will be implemented by health care providers and the general public (Michie, West, & Spring, 2013). By moving from theoretical models to practical application, interventions may be more effective, and we can directly observe boundary conditions for the theories. Thus, the new generation of models will benefit from an iterative process in which basic research informs application, and application informs basic research (Rothman, Klein, & Cameron, 2013).

One of the primary places that personality may be informative is in medicine. There is a growing emphasis in the medical world on the need for patient-centered approaches to care. Theory-based studies on personality and health can potentially inform risk models, decision making, and treatment options (Chapman et al., 2014). Personality assessments may help healthcare professionals make predictions of future health risks. With high treatment costs, interventions could be targeted more directly to those most likely to respond, thus saving time and costs that accrue from nonresponders.

How could this work in practice? At any given appointment, medical teams often collect background information, including disease history, weight, blood pressure, and in some cases risky health behaviors (e.g., smoking, drinking, physical inactivity). Intake assessments could include a brief personality measure, which would help the physician quickly get to know the patient better. The information could be included in the electronic health record, sharing the information with others on the care team, offering some immediate information about individual differences, risk status, and communication preferences. Treatments could be adjusted based on different traits. For example, as Conscientiousness is associated with adherence, those low in Conscientiousness could be provided with additional monitoring, reminders, and other tools. In turn, the additional information added to the health records will inform research on personality influences on patient–provider communication, health service use, and overall patient outcomes (Israel et al., 2014).

Another reason for specifying and testing specific theories that include causal clauses is to identify when and how to best intervene. For example, secure attachment has been related to optimal self-regulation; early interventions that teach parents parenting skills may help the parents raise self-regulated children and conscientious adults (Drake, Belsky, & Pasco Fearon, 2014). Motivation, which has implications for productivity and health, is influenced by parental behaviors and beliefs, peers, and the school environment. In the Dunedin Multidisciplinary Health and Development Study, childhood self-control predicted numerous midlife outcomes (including education, health, wealth, crime, parenting, and life satisfaction) in a linear fashion, suggesting that even children with good self-control benefit from improving their self-control skills further (Israel & Moffitt, 2014). However, the extent to which levels of self-control and other personality traits change through intervention has yet to be established.

The idea for personalized medicine and timed interventions certainly has merit, but the feasibility of such approaches needs to be tested (Israel & Moffitt, 2014), and ethics need to be carefully considered. Again, the theories underlying personality and health relationships should inform the assessments and interventions that are conducted.

**Conclusions**

Once the flaws and limits of single-factor, single-disease approaches such as the Type A personality were documented, the need for studying multiple personality factors predicting multiple outcomes emerged (Friedman & Booth-Kewley, 1987). Since then, the Five-Factor Model has provided a useful tool and heuristic lens for studying the personality side of personality–health relations. With a small, core set of factors, which at a broad level represents the universe of personality traits, multidimensional studies can be conducted. The resulting body of research has produced strikingly replicable results.

Conscientiousness has the clearest and most important influence on health. Its effects are comparable to or larger than those of many traditional medical risk factors (Chapman et al., 2011; Friedman & Kern, 2014; Shanahan et al., 2014). The

other four factors are also important, but their effects depend more on situations and life paths. Personality matters for health, but typically not in simple or straightforward ways; the two are connected through a complex array of intertwined circuits and wires. For example, individuals high on Extraversion, seeking stimulation and interactions with others, may develop unhealthy drinking and drug abuse if they attend a "party" college and proceed into a carousing career; but the same level of Extraversion might prove helpful when it leads individuals to establish good social networks of caring friends. Multiple pathways occur—behaviors, interactions with other people, situations encountered, the social context, and inner physiological reactions all are impacted by personality and in turn shape personality over time.

We have also emphasized the health outcomes side of the equation and the importance of postulating and testing mechanisms and pathways. Personality is a naturally valuable concept for understanding health because it captures biological bases, health behaviors, and situation selection, and it involves homeostatic forces and changes over time. For example, the neurotransmitter serotonin is related both to Conscientiousness and to a myriad of bodily homeostatic functions. As we have seen, conscientious behavior in turn often involves a variety of health-protective actions, ranging from less likelihood of smoking and risk-taking activities to safe driving and regular medical check ups. And Conscientiousness also leads to a host of healthier psychosocial environments, from more education and career success to better marriages (Friedman & Martin, 2011; Shanahan et al., 2014). More complete models of personality and health are important for identifying and clarifying causality, which in turn influences how and when interventions should occur.

Modern personality research based on a five-factor approach is clarifying the patterns, predictors, and trajectories of health and longevity. Big data, longitudinal studies with multiple outcomes including longevity, and other innovative empirical approaches can be combined with a growing array of advanced statistical methods, making it possible to test complex, dynamic models of life trajectories. There is no longer a need for short-term studies that correlate a trait and a disease. Instead, by unraveling the causal pathways, we can develop interventions that will be better informed and more effective, providing considerable value to both individuals and society.

## References

Aldwin, C. M., Spiro, A., & Park, C. L. (2006). Health, behavior, and optimal aging: A life span developmental perspective. In J. E Birren & K. W. Schaie (Eds.), *Handbook of the psychology of aging* (6th ed., pp. 85–104). New York, NY: Elsevier.

Almada, S. J., Zonderman, A. B., Shekelle, R. B., Dyer, A. R., Daviglus, M. L., Costa, P. T., Jr., & Stamler, J. (1991). Neuroticism and cynicism and risk of death in middle-aged men: The Western Electric Study. *Psychosomatic Medicine*, *53*, 165–175.

Anderson, B., Fagan, P., Woodnutt, T., & Chamorro-Premuzic, T. (2012). Facebook psychology: Popular questions answered by research. *Psychology of Popular Media Culture*, *1*, 23–37.

Atherton, O. E., Robins, R. W., Rentfrow, P. J., & Lamb, M. E. (2014). Personality correlates of risky health outcomes: Findings from a large internet study. *Journal of Research in Personality*, *50*, 56–60.

Baltes, P. B., & Baltes, M. M. (1990). Psychological perspectives on successful aging: The model of selective optimization with compensation. In P. B. Baltes & M. M. Baltes (Eds.), *Successful aging: Perspectives from the behavioral sciences* (pp. 1–34). New York, NY: Cambridge University Press.

Bambrick, P., & Bonder, B. (2005). Older adults' perceptions of work. *Work: Journal of Prevention, Assessment, and Rehabilitation*, *24*, 77–84.

Bauer, D. J., & Hussong, A. M. (2009). Psychometric approaches for developing commensurate measure across independent studies: Traditional and new models. *Psychological Methods*, *14*, 101–125.

Block, J. (1993). Studying personality the long way. In D. C. Funder, R. D. Parke, C. Tomlinson-Keasey, & K. Widaman (Eds.), *Studying lives through time: Personality and development* (pp. 9–41). Washington, DC: American Psychological Association.

Bogg, T., & Roberts, B. W. (2004). Conscientiousness and health-related behaviors: A meta-analysis of the leading behavioral contributors to mortality. *Psychological Bulletin*, *130*, 887–919.

Bogg, T., & Roberts, B. W. (2013). The case for conscientiousness: Evidence and implications for a personality trait marker of health and longevity. *Annals of Behavioral Medicine*, *45*, 278–288.

Booth, T., Mottus, R., Corley, J., Gow, A. J., Henderson, R. D., Maniega, S. M., … Deary, I. J. (2014). Personality, health, and brain integrity: The Lothian birth cohort study 1936. *Health Psychology*, *33*(12), 1477–1486.

Boyce, C. J., & Wood, A. M. (2011). Personality prior to disability determines adaptation: Agreeable individuals recover lost life satisfaction faster and more completely. *Psychological Science*, *22*, 1397–1402.

Bunde, J., & Suls, J. (2006). A quantitative analysis of the relationship between the Cook-Medley Hostility Scale and traditional coronary artery disease risk factors. *Health Psychology*, *25*, 493–500.

Carver, C. S., & Connor-Smith, J. (2010). Personality and coping. *Annual Review of Psychology*, *61*, 679–704.

Carver, C. S., & Miller, C. J. (2006). Relations of serotonin function to personality: Current views and a key methodological issue. *Psychiatry Research*, *144*, 1–15.

Caspi, A., Houts, R., Belsky, D. W., Goldman-Mellor, S., Harrington, H. L., Israel, S., … Moffitt, T. E. (2014). The 'p factor': One general psychopathology factor in the structure of psychiatric disorders? *Clinical Psychological Science*, *2*, 119–137.

Caspi, A., Roberts, B. W., & Shiner, R. L. (2005). Personality development: Stability and change. *Annual Review of Psychology*, *56*, 453–484.

Cavigelli, S. A. (2005). Animal personality and health. *Behaviour*, *142*, 1223–1244.

Chapman, B. P., Fiscella, K., Kawachi, I., & Duberstein, P. R. (2010). Personality, socioeconomic status, and all-cause mortality in the United States. *American Journal of Epidemiology*, *171*, 83–92.

Chapman, B. P., Hampson, S., & Clarkin, J. (2014). Personality-informed interventions for healthy aging: Conclusions from a National Institute on Aging work group. *Developmental Psychology*, *50*, 1426–1441.

Chapman, B. P., Roberts, B. W., & Duberstein, P. (2011). Personality and longevity: Knowns, unknowns, and implications for public health and personalized medicine. *Journal of Aging Research*, 759–170.

Chapman, B. P., Roberts, B., Lyness, J., & Duberstein, P. (2013). Personality and physician-assessed illness burden in older primary care patients over 4 years. *American Journal of Geriatric Psychiatry*, *21*, 737–746.

Charles, S. T., Kato, K., Gatz, M., & Pedersen, N. L. (2008). Physical health 25 years later: The predictive ability of neuroticism. *Health Psychology*, *27*, 369–378.

Cheng, H., & Furnham, A. (2013). Factors influencing adult physical health after controlling for current conditions: Evidence from a British cohort. *PLoS One*, *8*, e66204.

Christensen, A. J., Ehlers, S. L., Wiebe, J. S., Moran, P. J., Raichle, K., & Lawton, W. J. (2002). Patient personality and mortality: A 4-year prospective examination of chronic renal insufficiency. *Health Psychology*, *21*, 315–320.

Connor-Smith, J. K., & Flachsbart, C. (2007). Relations between personality and coping: A meta-analysis. *Journal of Personality and Social Psychology*, *93*, 1080–1107.

Costa, P. T., & McCrae, R. R. (1987). Neuroticism, somatic complaints, and disease: Is the bark worse than the bite? *Journal of Personality*, *55*, 299–316.

Curran, P. J., & Hussong, A. M. (2009). Integrative data analysis: The simultaneous analysis of multiple data sets. *Psychological Methods*, *14*, 81–100.

Denollet, J., Sys, S. U., Stroobant, N., Rombouts, H., Gillebert, T. C., & Brutsaert, D. L. (1996). Personality as independent predictor of long-term mortality in patients with coronary heart disease. *Lancet*, *347*, 417–421

DeYoung, C. G., & Gray, J. R. (2009). Personality neuroscience: Explaining individual differences in affect, behavior, and cognition. In P. J. Corr & G. Matthews (Eds.), *The Cambridge handbook of personality psychology* (pp. 323–346). New

York, NY: Cambridge University Press.

DeYoung, C. G., Hirsh, J. B., Shane, M. S., Papademetris, X., Rajeevan, N., & Gray, J. R. (2010). Testing predictions from personality neuroscience: Brain structure and the big five. *Psychological Science*, *21*, 820–828.

Diener, E. (2012). New findings and future directions for subjective well-being research. *American Psychologist*, *67*, 590–597.

Drake, K., Belsky, J., & Pasco Fearon, R. M. (2014). From early attachment to engagement with learning in school: The role of self-regulation and persistence. *Developmental Psychology*, *50*, 1350–1361.

Duberstein, P. R., Chapman, B. P., Tindle, H. A., Sink, K. M., Bamonti, P., Robbins, J., … Franks, P. (2011). Personality and risk for Alzheimer's disease in adults 72 years of age and older: A 6-year follow-up. *Psychology and Aging*, *26*, 351–362.

Duckworth, A. L., & Kern, M. L. (2011). A meta-analysis of the convergent validity for self-control measure. *Journal of Research in Personality*, *45*, 259–268.

Eaton, N. R., Krueger, R. F., South, S. C., Gruenewalk, T. L., Seeman, T. E., & Roberts, B. W. (2012). Genes, environments, personality, and successful aging: Toward a comprehensive developmental model in later life. *The Journals of Gerontology Series A*, *67A*, 480–488.

Eichstaedt, J. C., Schwartz, H. A., Kern, M. L., Park, G., Labarthe, D. R., Merchant, R. M., … Seligman, M. E. P. (2015). Psychological language on Twitter predicts county-level heart disease mortality. *Psychological Science*, *26*, 159–169.

Eisenberg, N., Duckworth, A. L., Spinrad, T. L., & Valiente, C. (2014). Conscientiousness: Origins in childhood? *Developmental Psychology*, *50*, 1331–1349.

Elder, G. H., Jr., Pavalko, E. K., & Clipp, E. C. (1993). *Working with archival data: Studying lives*. Newbury Park, CA: Sage.

Ferguson, E., & Bibby, P. A. (2012). Openness to experience and all-cause mortality: A meta-analysis and $r_{equivalent}$ from risk ratios and odds ratios. *British Journal of Health Psychology*, *17*, 85–102.

Finch, J. F., Baranik, L. E., Liu, Y., & West, S. G. (2012). Physical health, positive and negative affect, and personality: A longitudinal analysis. *Journal of Research in Personality*, *46*, 537–545.

Fratkin, J. L., Sinn, D. L., Patall, E. A., & Gosling, S. D. (2013). Personality consistency in dogs: A meta-analysis. *PLoS One*, *8*, e54907.

Fredrickson, B. L. (2001). The role of positive emotions in positive psychology: The broaden and-build theory of positive emotions. *American Psychologist*, *56*, 218–226.

Friedman, H. S. (1991). *Self-healing personality: Why some people achieve health and others succumb to illness*. New York, NY: Henry Holt.

Friedman, H. S. (2000). Long-term relations of personality, health: Dynamisms, mechanisms, and tropisms. *Journal of Personality*, *68*, 1089–1107.

Friedman, H. S. (2007). Personality, disease, and self-healing. In H. S. Friedman & R. C. Silver (Eds.), *Foundations of health psychology* (pp. 172–199). New York, NY: Oxford University Press.

Friedman, H. S., & Booth-Kewley, S. (1987). The "disease-prone personality": A meta-analytic view of the construct. *American Psychologist*, *42*, 539–555.

Friedman, H. S., & Kern, M. L. (2014). Personality, well-being, and health. *Annual Review of Psychology*, *65*, 719–742.

Friedman, H. S., Kern, M. L., Hampson, S. E., & Duckworth, A. L. (2014). A new lifespan approach to conscientiousness and health: Combining the pieces of the causal puzzle. *Developmental Psychology*, *50*, 1377–1389.

Friedman, H. S., Kern, M. L., & Reynolds, C. A. (2010). Personality and health, subjective well-being, and longevity as adults age. *Journal of Personality*, *78*, 179–216.

Friedman, H. S. & Martin, L. R. (2011). *The longevity project: Surprising discoveries for health and long life from the landmark eight-decade study*. New York, NY: Hudson Street Press.

Friedman, H. S., Tucker, J., Tomlinson-Keasey, C., Schwartz, J. Wingard, D., & Criqui, M. H. (1993). Does childhood personality predict longevity? *Journal of Personality and Social Psychology*, *65*, 176–185.

Fries, J. F. (1990). Medical perspectives upon successful aging. In P. B. Baltes & M. M. Baltes (Eds.), *Successful aging: Perspectives from the behavioral sciences* (pp. 35–49). New York, NY: Cambridge University Press.

Funder, D. C., & Sneed, C. D. (1993). Behavioral manifestations of personality: An ecological approach to judgmental accuracy. *Journal of Personality and Social Psychology*, *64*, 479–490.

Gill, A. (2004). Personality and language: The projection and perception of personality in computer-mediated communication. Doctoral dissertation, University of Edinburgh, United Kingdom. Retrieved from

Goodwin, R. G., & Friedman, H. S. (2006). Health status and the Five Factor personality traits in a nationally representative sample. *Journal of Health Psychology*, *11*, 643–654.

Gosling, S. D., Ko, S. J., Mannarelli, T., & Morris, M. E. (2002). A room with a cue: Personality judgments based on offices and bedrooms. *Personality Processes and Individual Differences*, *82*, 379–398.

Hagger-Johnson, G., Sabia, S., Nabi, H., Brunner, E., Kivimaki, M., Shipley, M., & Singh–Manoux, A. (2012). Low conscientiousness and risk of all-cause, cardiovascular and cancer mortality over 17 years: Whitehall II cohort study. *Journal of Psychosomatic Research*, *73*, 98–103.

Hampson, S. E. (2008). Mechanisms by which childhood personality traits influence adult well-being. *Current Directions in Psychological Science*, *17*, 264–268.

Hampson, S. E., Edmonds, G. W., Goldberg, L. R., Dubanoski, J. P., & Hillier, T. A. (2013). Childhood conscientiousness relates to objectively measured adult physical health four decades later. *Health Psychology*, *32*, 925–928.

Hampson, S. E., Goldberg, L. R., Vogt, T. M., & Dubanoski, J. P. (2006). Forty years on: Teachers' assessments of children's personality traits predict self-reported health behaviors and outcomes at midlife. *Health Psychology*, *25*, 57–64.

Heckman, J. J., Stixrud, J., & Urzua, S. (2006). The effects of cognitive and noncognitive abilities on labor market outcomes and social behavior. *Journal of Labor Economics*, *24*, 411–482.

Hill, P. L., & Roberts, B. W. (2011). The role of adherence in the relationship between conscientiousness and perceived health. *Health Psychology*, *30*, 797–804.

Hofer, S. M., & Piccinin, A. M. (2009). Integrative data analysis through coordination of measurement and analysis protocol across independent longitudinal studies. *Psychological Methods, 14*, 150–164.

Hofer, S. M., & Piccinin, A. M. (2010). Toward an integrative science of life-span development and aging. *Journals of Gerontology Series B: Psychological Sciences & Social Sciences*, *65*, 269–278.

Human, L. J., Biesanz, J. C., Miller, G. E., Chen, E., Lachman, M. E., & Seeman, T. E. (2013). Is change bad? Personality change is associated with poorer psychological health and greater metabolic syndrome in midlife. *Journal of Personality*, *81*, 249–259.

Huppert, F. A., & So, T. T. C. (2013). Flourishing across Europe: Application of a new conceptual framework for defining well-being. *Social Indicators Research*, *110*, 837–861.

Hutchinson, J. G., & Ruiz, J. M. (2011). Neuroticism and cardiovascular response in women: Evidence of effects on blood pressure recovery. *Journal of Personality*, *79*, 277–302.

Idler, E. L., & Kasl, S. V. (1991). Health perceptions and survival: Do global evaluations of health status really predict mortality? *Journal of Gerontology: Social Sciences*, *46*, S55–S65.

Israel, S., & Moffitt, T. E. (2014). Conscientiousness in primary care: An opportunity for disease prevention and health

promotion. *Developmental Psychology*, *50*, 1475–1477.

Israel, S., Moffitt, T. E., Belsky, D. W., Hancox, R. J., Poulton, R., Roberts, B., … Caspi, A. (2014). Translating personality psychology to help personalize preventative medicine for young adult patients. *Journal of Personality and Social Psychology*, *106*, 484–498.

Iwasa, H., Masui, Y., Gondo, Y., Inagaki, H., Kawaai, C., & Suzuki, T. (2008). Personality and all-cause mortality among older adults dwelling in a Japanese community: A five-year population-based prospective cohort study. *The American Journal of Geriatric Psychiatry*, *16*, 399–405.

Jackson, J. J., Wood, D., Bogg, T., Walton, K. E., Harms, P. D., & Roberts, B. W. (2010). What do conscientious people do? Development and validation of the Behavioral Indicators of Conscientiousness (BIC). *Journal of Research in Personality*, *44*, 501–511.

Jaconelli, A., Stephan, Y., Canada, B., & Chapman, B. P. (2013). Personality and physical functioning among older adults: The moderating role of education. *The Journals of Gerontology: Series B: Psychological Sciences & Social Sciences*, *68B*, 553–557.

Jang, K. L., Livesley, W. J., Angleitner, A., Riemann, R., & Vernon, P. A. (2002). Genetic and environmental influences on the covariance of facets defining the domains of the five-factor model of personality. *Personality and Individual Differences*, *33*, 83–101.

Jensen-Campbell, L. A., Knack, J. M., & Gomez, H. L. (2010). The psychology of nice people. *Social and Personality Psychology Compass*, *4*, 1042–1056.

Jensen-Campbell, L. A., & Malcolm, K. T. (2007). The importance of conscientiousness in adolescent interpersonal relationships. *Personality and Social Psychology Bulletin*, *33*, 368–383.

Kaplan, R. M. (1994). The Ziggy theorem: Toward an outcomes-focused health psychology. *Health Psychology*, *13*, 451–460.

Karademas, E. C., & Tsaousis, I. (2014). The relationship of patient and spouse personality to cardiac patients' health: Two observational studies of mediation and moderation. *Annals of Behavioral Medicine*, *47*, 79–91.

Kemeny, M. E. (2007). Psychoneuroimmunology. In H. S. Friedman & R. C. Silver (Eds.), *Foundations of health psychology* (pp. 92–116). New York, NY: Oxford University Press.

Kern, M. L., Duckworth, A. L., Urzua, S., Loeber, R., Loeber, M., & Lynam, D. (2013). Do as you're told! Facets of agreeableness and early adult outcomes for inner city boys. *Journal of Research in Personality*, *47*, 795–799.

Kern, M. L., Eichstaedt, J. C., Schwartz, H. A., Dziurzynski, L., Ungar, L. H., Stillwell, D. J., … Seligman, M. E. P. (2014). The online social self: An open vocabulary approach to personality. *Assessment*, *21*, 158–169.

Kern, M. L., Eichstaedt, J. C., Schwartz, H. A., Park, G., Ungar, L. H., Stillwell, D. J., … Seligman, M. E. P. (2014). From "sooo excited!!!" to "so proud": Using language to study development. *Developmental Psychology*, *50*, 178–188.

Kern, M. L., & Friedman, H. S. (2008). Do conscientious individuals live longer? A quantitative review. *Health Psychology*, *27*, 505–512.

Kern, M. L., & Friedman, H. S. (2010). Why do some people thrive while others succumb to disease and stagnation? Personality, social relations, and resilience. In P. S. Fry & C. L. M. Keyes (Eds.), *Frontiers of resilient aging* (pp. 162–184). New York, NY: Cambridge University Press.

Kern, M. L., Friedman, H. S., Martin, L. R., Reynolds, C. A., & Luong, G. (2009). Personality, career success, and longevity: A lifespan analysis. *Annals of Behavioral Medicine*, *37*, 154–163.

Kern, M. L., Hampson, S. E., Goldberg, L. R., & Friedman, H. S. (2014). Integrating prospective longitudinal data: Modeling personality and health in the Terman Life Cycle and Hawaii Longitudinal studies. *Developmental Psychology*, *50*, 1390–1406.

Korotkov, D. (2008). Does personality moderate the relationship between stress and health behavior? Expanding the nomological network of the five-factor model. *Journal of Research in Personality*, *42*, 1418–1426.

Korten, A. E., Jorm, A. F., Jiao, Z., Letenneur, L., Jacomb, P. A., Henderson, A. S., … Rodgers, B. (1999). Health, cognitive, and psychosocial factors as predictors of mortality in an elderly community sample. *Journal of Epidemiology & Community Health*, *53*, 83–88.

Latzman, R. D., Hopkins, W. D., Keebaugh, A. C., & Young, L. J. (2014). Personality in chimpanzees (Pan troglodytes): Exploring the hierarchical structure and associations with the vasopressin V1A receptor gene. *PLoS One*, *9*, e95741.

Leclerc, J., Rahn, M., & Linden, W. (2006). Does personality predict blood pressure over a 10-year period? *Personality and Individual Differences*, *40*, 1313–1321.

Lodi-Smith, J., Jackson, J., Bogg, T., Walton, K., Wood, D., Harms, P., & Roberts, B. W. (2010). Mechanisms of health: Education and health-related behaviours partially mediate the relationship between conscientiousness and self-reported physical health. *Psychology & Health*, *25*, 305–319.

Lodi-Smith, J., & Roberts, B. W. (2007). Social investment and personality: A meta-analysis of the relationship of personality traits to investment in work, family, religion, and volunteerism. *Personality and Social Psychology Review*, *11*, 1–19.

Low, L.-F., Harrison, F., & Lackersteen, S. M. (2013). Does personality affect risk for dementia? A systematic review and meta-analysis. *American Journal of Geriatric Psychiatry*, *21*, 713–728.

Lyubomirsky, S., Sheldon, K. M., & Schkade, D. (2005). Pursuing happiness: The architecture of sustainable change. *Review of General Psychology*, *9*, 111–131.

Magee, C. A., Heaven, P. C. L., & Miller, L M. (2013). Personality change predicts self-reported mental and physical health. *Journal of Personality*, *81*, 324–334.

Magnus, K., Diener, E., Fujita, F., & Pavot, W. (1993). Extraversion and neuroticism as predictors of objective life events: A longitudinal analysis. *Journal of Personality and Social Psychology*, *65*, 1046–1053.

McCowan, B., Beisner, B. A., Capitanio, J. P., Jackson, M. E., Cameron, A. N., Seil, S., … Fushing, H. (2011). Network stability is a balancing act of personality, power, and conflict dynamics in rhesus macaque societies. *PLoS One*, *6*, e22350.

McEwen, B. S. (2006). Protective and damaging effects of stress mediators: Central role of the brain. *Dialogues of Clinical Neuroscience*, *8*, 283–293.

Mehl, M. R., Gosling, S. D., & Pennebaker, J. W. (2006). Personality in its natural habitat: Manifestations and implicit folk theories of personality in daily life. *Journal of Personality and Social Psychology*, *90*, 862–877.

Mehl, M. R., & Pennebaker, J. W. (2003). The sounds of social life: A psychometric analysis of students' daily social environments and natural conversations. *Journal of Personality and Social Psychology*, *84*, 857–870.

Mehta, P. H., & Gosling, S. D. (2008). Bridging human and animal research: A comparative approach to personality and health. *Brain, Behavior, & Immunity*, *22*, 651–666.

Mermelstein, R. J., & Revenson, T. A. (2013). Applying theory across settings, behaviors, and populations: Translational challenges and opportunities. *Health Psychology*, *32*, 592–596.

Michie, S., West, R., & Spring, B. (2013). Moving from theory to practice and back in social and health psychology. *Health Psychology*, *32*, 581–585.

Miller, G. E., Cohen, S., Rabin, B. S., Skoner, D. P., & Doyle, W. J. (1999). Personality and tonic cardiovascular, neuroendocrine, and immune parameters. *Brain, Behavior, and Immunity*, *13*, 109–123.

Mõttus, R., Johnson, W., Starr, J. M., & Deary, I. J. (2012). Correlates of personality trait levels and their changes in very old age: The Lothian birth cohort 1921. *Journal of Research in Personality*, *46*, 271–278.

Mroczek, D. K. (2014). Personality plasticity, health aging, and interventions. *Developmental Psychology*, *50*, 1470–1474.

Mroczek, D. K., & Spiro, A. (2007). Personality change influences mortality in older men. *Psychological Science*, *18*, 371–376.

Mroczek, D. K., Spiro, A., & Turiano, N. A. (2009). Do health behaviors explain the effect of neuroticism on mortality? Longitudinal findings from the VA Normative Aging Study. *Journal of Research in Personality*, *43*, 653–659.

Nater, U. M., Hoppmann, C., & Klumb, P. L. (2010). Neuroticism and conscientiousness are associated with cortisol diurnal profiles in adults: Role of positive and negative affect. *Psychoneuroendocrinology*, *35*, 1573–1577.

Nesselroade, J. R. (1991). The warp and woof of the developmental fabric. In R. Downs, L. Liben, & D. Palermo (Eds.), *Visions of development, the environment, and aesthetics: The legacy of Joachim F. Wohlwill* (pp. 213–240). Hillsdale, NJ: Erlbaum.

O'Cleirigh, C., Ironson, G., Weiss, A., & Costa, P. T. (2007). Conscientiousness predicts disease progression (CD4 number and viral load) in people living with HIV. *Health Psychology*, *26*, 473–480.

O'Connor, D. B., Conner, M., Jones, F., McMillan, B., & Ferguson, E. (2009). Exploring the benefits of conscientiousness: An investigation of the role of daily stressors and health behaviors. *Annals of Behavioral Medicine*, *37*, 184–196.

Ozer, D. J., & Benet-Martinez, V. (2006). Personality and the prediction of consequential outcomes. *Annual Review of Psychology*, *57*, 401–421.

Patrick, C. J. (2014). Understanding the role of conscientiousness in healthy aging: Where does the brain come in? *Developmental Psychology*, *50*, 1465–1469.

Paunonen, S. V. (1998). Hierarchical organization of personality and prediction of behavior. *Journal of Personality and Social Psychology*, *74*, 538–556.

Paunonen, S. V., & Ashton, M. C. (2001). Big Five factors and facets and the prediction of behavior. *Journal of Personality and Social Psychology*, *81*, 524–539.

Ploubidis, G. B., & Grundy, E. (2009). Personality and all cause mortality: Evidence for indirect links. *Personality and Individual Differences*, *47*, 203–208.

Pressman, S. D., & Cohen, S. (2005). Does positive affect influence health? *Psychological Bulletin*, *131*, 925–971.

Raposa, E. B., Bower, J. E., Hammen, C. L., Najman, J. M., & Brennan, P. A. (2014). A developmental pathway from early life stress to inflammation: The role of negative health behaviors. *Psychological Science*, *25*, 1268–1274.

Repetti, R. L., Taylor, S. E., & Seeman, T. E. (2002). Risky families: Social environments and the mental and physical health of offspring. *Psychological Bulletin*, *128*, 330–366.

Reynolds, C. A., Finkel, D., McArdle, J. J., Gatz, M., Berg, S., & Pedersen, N. L. (2005). Quantitative genetic analysis of latent growth curve models of cognitive abilities in adulthood. *Developmental Psychology*, *41*, 3–16.

Richardson, E. D. (2005). Memory improvement: Are we there yet? *PsycCRITIQUES*, *50*(3), np.

Roberts, B. W., & Bogg, T. (2004). A longitudinal study of the relationships between conscientiousness and the social-environmental factors and substance-use behaviors that influence health. *Journal of Personality*, *72*, 325–353.

Roberts, B. W., Kuncel, N. R., Shiner, R., Caspi, A., & Goldberg, L. R. (2007). The power of personality: The comparative validity of personality traits, socioeconomic status, and cognitive ability for predicting important life outcomes. *Perspectives on Psychological Science*, *2*, 313–345.

Roberts, B. W., Lejuez, C., Krueger, R. F., Richards, J. M., & Hill, P. L. (2014). What is conscientiousness and how can it be assessed? *Developmental Psychology*, *50*, 1315–1330.

Roberts, B. W., Smith, J., Jackson, J. J., & Edmonds, G. (2009). Compensatory conscientiousness and health in older

couples. *Psychological Science*, *20*, 553–559.

Rothman, A. J., Klein, W. M. P., & Cameron, L. D. (2013). Advancing innovations in social/personality psychology and health: Opportunities and challenges. *Health Psychology*, *32*, 602–608.

Ryan, R. M., & Deci, E. L. (2001). On happiness and human potential: A review of research on hedonic and eudaimonic well-being. *Annual Review of Psychology*, *52*, 141–166.

Ryff, C. D., & Keyes, C. L. M. (1995). The structure of psychological well-being revisited. *Journal of Personality and Social Psychology*, *69*, 719–727.

Sallis, J. F. (2000). Age-related decline in physical activity: A synthesis of human and animal studies. *Medicine and Science in Sports & Exercise*, *32*, 1598–1600.

Sampaio, A., Soares, J. M., Countinho, J., Sousa, N., & Gonçalves, Ó. F. (2013). The big five default brain: Functional evidence. *Brain Structure and Function, 219*, 1913–1922.

Schwartz, H. A., Eichstaedt, J. C., Kern, M. L., Dziurzynski, L., Lucas, R. E., Agrawal, M., … Ungar, L. H. (2013). Characterizing geographic variation in well-being using tweets. In *Proceedings of the Seventh International AAAI Conference on Weblogs and Social Media (ICWSM)*, Boston, MA.

Segerstrom, S. C., & O'Connor, D. B. (2012). Stress, health and illness: Four challenges for the future. *Psychology & Health*, *27*, 128–140.

Seligman, M. E. P. (2011). *Flourish*. New York, NY: Simon & Schuster.

Shanahan, M. J., Hill, P. L., Roberts, B. W., Eccles, J., & Friedman, H. S. (2014). Conscientiousness, health, and aging: The life course of personality model. *Developmental Psychology*, *50*, 1407–1425.

Shipley, B. A., Weiss, A., Der, G., Taylor, M. D., & Deary, I. J. (2007). Neuroticism, extraversion, and mortality in the UK Health and Lifestyle Survey: A 21-year prospective cohort study. *Psychosomatic Medicine*, *69*, 923–931.

Slobodskaya, H. R., Ashmetova, O. A., & Rippinen, T. O. (2014). Does personality matter more in difficult circumstances? *Journal of Research in Personality*, *48*, 33–44.

Smith, T. W. (2006). Personality as risk and resilience in physical health. *Current Directions in Psychological Science*, *15*, 227–231.

Smith, T. W., Baron, C. E., & Grove, J. L. (2014). Personality, emotional adjustment, and cardiovascular risk: Marriage as a mechanism. *Journal of Personality*, *82*, 502–514.

Smith, T. W., Glazer, K., Ruiz, J. M., & Gallo, L. C. (2004). Hostility, anger, aggressiveness, and coronary heart disease: An interpersonal perspective on personality, emotion, and health. *Journal of Personality*, *72*, 1217–1270.

Smith, T. W., & Williams, P. G. (1992). Personality and health: Advantages and limitations of the five-factor model. *Journal of Personality*, *60*, 395–423.

South, S. C., & Krueger, R. F. (2014). Genetic strategies for probing conscientiousness and its relationship to aging. *Developmental Psychology*, *50*, 1362–1376.

Staudinger, U. M., Cornelius, S. W., & Baltes, P. B. (1989). The aging of intelligence: Potential and limits. *Annals of the American Academy of Political and Social Science*, *503*, 43–59.

Steel, P., Schmidt, J., & Shultz, J. (2008). Refining the relationship between personality and subjective well-being. *Psychological Bulletin*, *134*, 138–161.

Sutin, A. R., Terracciano, A., Deiana, B., Naitza, S., Ferrucci, L., Uda, M., … Costa, P. T., Jr. (2010). High neuroticism and low conscientiousness are associated with interleukin-6. *Psychological Medicine*, *40*, 1485–1493.

Sutin, A. R., Terracciano, A., Deiana, B., Uda, M., Schlessinger, D., Lakatta, E. G., & Costa, P. T. (2010). Cholesterol, triglycerides, and the Five-Factor Model of personality. *Biological Psychology*, *84*, 186–191.

Taga, K. T., Friedman, H. S., & Martin, L. R. (2009). Early personality predictors of mortality risk following conjugal bereavement. *Journal of Personality*, *77*, 669–690.

Takahashi, Y., Edmonds, G. W., Jackson, J. J., & Roberts, B. W. (2013). Longitudinal correlated changes in conscientiousness, preventative health-related behaviors, and self-perceived physical health. *Journal of Personality*, *81*, 417–427.

Tam, T., & Wi, H. F. (2014). Noncognitive traits as fundamental causes of health inequality: Baseline findings from urban China. *Chinese Sociological Review*, *46*, 32–62.

Tay, L., Tan, K., Diener, E., & Gonzalez, E. (2012). Social relations, health behaviors, and health outcomes: A survey and synthesis. *Applied Psychology: Health and Well-Being*, *5*, 28–78.

Taylor, M. D., Whiteman, M. C., Fowkes, G. R., Lee, A. J., Allerhand, M., & Deary, I. J. (2009). Five Factor Model personality traits and all cause mortality in the Edinburgh Artery Study cohort. *Psychosomatic Medicine*, *71*, 631–641.

Taylor, S. E. (2011). Social support: A review. In H. S. Friedman (Ed.), *The Oxford handbook of health psychology* (pp. 189–214). New York, NY: Oxford University Press.

Terracciano, A., Löckenhoff, C. E., Zonderman, A. B., Ferrucci, L., & Costa, P. T. (2008). Personality predictors of longevity: Activity, emotional stability, and conscientiousness. *Psychosomatic Medicine*, *70*, 621–627.

Tomlinson-Keasey, C. (1993). Opportunities and challenges posted by archival data sets. In D. C. Funder, R. D. Parke, C. Tomlinson-Keasey, & K. Widaman (Eds.), *Studying lives through time: Personality and development* (pp. 65–92). Washington, DC: American Psychological Association.

Turiano, N. A., Chapman, B. P., Gruenewald, T. L., & Mroczek, D. K. (2015). Personality and the leading behavioral contributors of mortality. *Health Psychology*, *34*(1), 51–60.

Turiano, N. A., Pitzer, L., Armour, C., Karlamangla, A., Ryff, C. D., & Mroczek, D. K. (2012). Personality trait level and change as predictors of health outcomes: Findings from a National Study of Americans (MIDUS). *Journals of Gerontology Series B–Psychological Sciences and Social Sciences*, *67*, 4–12.

Vaillant, G. E. (2012). *Triumphs of experience: The men of the Harvard Grant Study*. Cambridge, MA: Belknap Press.

Ware, J. E., Kosinski, M., & Keller, S. K. (1994). *SF-36 physical and mental health summary scales: A user's manual*. Boston, MA: The Health Institute.

Watson, D., & Pennebaker, J. W. (1989). Health complaints, stress, and distress: Exploring the central role of negative affectivity. *Psychological Review*, *96*, 234–254.

Weiss, A., & Costa, P. T., Jr. (2005). Domain and facet personality predictors of all-cause mortality among Medicare patients Aged 65 to 100. *Psychosomatic Medicine*, *67*, 715–723.

Weiss, A., Gale, C. R., Batty, G. D., & Deary, I. J. (2009). Emotionally stable, intelligent men live longer: The Vietnam Experience Study cohort. *Psychosomatic Medicine*, *71*, 385–394.

White, R. W., Harpaz, R., Shah, N. H., DuMouchel, W., & Horvitz, E. (2014). Toward enhancing pharmacovigilance using patient-generated data on the internet. *Clinical Pharmacology & Therapeutics*, *96*, 239–246.

Williams, R., & Williams, V. (2012). *Anger kills: Seventeen strategies for controlling hostility that can harm your health*. New York, NY: Harper Collins.

Wilson, R. S., Mendes de Leon, C. F., Bienias, J. L., Evans, D. A., & Bennett, D. A. (2004). Personality and mortality in old age. *Journals of Gerontology B: Psychological Sciences & Social Sciences*, *59B*, P110–P116.

Yang, S.-H., White, R. W., & Horvitz, E. (2013, July). Pursuing insights about healthcare utilization via geocoded search queries. *SIGIR'13*, Dublin, Ireland.

**Margaret L. Kern**

University of Pennsylvania

**Howard S. Friedman**

Howard S. Friedman, Department of Psychology, University of California, Riverside.