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Trajectories of Multiple Subjective Well-Being Facets Across Old Age: The Role of Health and Personality

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Subjective well-being is often characterized by average stability across old age, but individual differences are substantial and not yet fully understood. This study targets physical and cognitive health and personality as individual difference characteristics and examines their unique and interactive roles for level and change in a number of different facets of subjective well-being. We make use of medical diagnoses, performance-based indicators of physical (grip strength) and cognitive functioning (Digit Symbol), and extraversion and neuroticism and apply parallel sets of multilevel growth models to multiyear well-being data obtained in the Berlin Aging Study 2 (N = 1,216; M_{age} = 71; SD = 3.84; 51% women) and the German Socio-Economic Panel (N = 3,418; M_{age} = 70; SD = 6.89; 51% women). Results revealed by and large average stability of life satisfaction, morale, and emotions (anger, fear, sadness, happiness) across old age. Most important for our research questions, higher morbidity, poor performance on grip strength and perceptual speed tests, lower extraversion, and higher neuroticism were each uniquely associated with lower life satisfaction, morale, and positive affect and higher negative affect. Some evidence emerged for facet-specific health–personality interaction effects in predicting

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affective experiences, but effects observed were not consistent across studies and of small size. We take our findings to indicate that health and personality traits constitute important individual difference characteristics for our understanding of subjective well-being in old age and that these likely do not interact with one another to shape well-being. We discuss theoretical and practical implications.

Keywords: well-being, health, personality, BASE-II, SOEP

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Many empirical reports indicate that average levels of subjective well-being remain relatively stable throughout adulthood and old age (Charles, Reynolds, & Gatz, 2001; Diener, Lucas, & Scollon, 2009; Kunzmann, Little, & Smith, 2000); however, substantial individual differences in level and change exist (Mroczek & Spiro, 2005). Developmental theory and empirical research have repeatedly noted that aspects of physical and cognitive health as well as personality are each associated with evaluative and affective well-being in old age (Charles, 2010; DeNeve & Cooper, 1998), but their exact interplay and unique effects are less well understood. For example, it is unclear how predictive associations of extraversion and neuroticism fare when age-related decrements in physical and cognitive health become increasingly prominent. It is also possible that personality dimensions buffer or exacerbate the deleterious effects of poor health through instrumental (behavioral) pathways (e.g., people high on extraversion seeking and maintaining social engagement) or temperamental pathways (e.g., people high on neuroticism perceiving greater health risks; Jokela, Hakulinen, Singh-Manoux, & Kivimäki, 2014). To examine these questions, we apply parallel sets of growth models to multiyear subjective well-being data obtained in the Berlin Aging Study 2 (N = 1,216; M_{age} = 71 years; range 60–88; 51% women) and the German Socio-Economic Panel (N = 3,418; M_{age} = 70; range 60–100 years; 51% women). We specifically ask whether key indicators of physical and cognitive health (morbidity, performance-based measures of grip strength and perceptual speed) and personality (extraversion and neuroticism) uniquely and interactively predict levels of and changes in a number of central facets of subjective well-being (life satisfaction, morale, happy, angry, fearful, sad).

Trajectories of Subjective Well-Being in Old Age

Constructs of subjective well-being are multidimensional and encompass evaluative components such as life satisfaction and psychological morale as well as affective experiences of positive and negative emotions (Diener, Oishi, & Lucas, 2003; Diener, 2009). Many developmental theories maintain that subjective well-being remains on average relatively stable across adulthood and old age (Brandtstädter, 1999; Baltes & Baltes, 1990). For example, the socioemotional selectivity theory contends that a limited future time perspective elicits a motivational shift toward optimizing well-being via the regulation of emotional states (Carstensen, 2006). These conceptual notions are supported by a myriad of empirical reports of mean-level stability and/or increases in the experience of positive emotions and decreases in the experience of negative emotions (Charles et al., 2001; Diener et al., 2009; Kunzmann et al., 2000). In the midst of such prevailing stability, substantial individual differences in levels of and changes in well-being across old age have long been documented (see Gerstorf & Ram, 2013). Some older adults are able to remain stable and positive throughout old age whereas others take a precipitous fall.

The Role of Physical and Cognitive Health

Such heterogeneity can in part be attributed to the pervasive physical and cognitive health challenges characteristic of old age (Crimmins, Hayward, & Saito, 1996; Lindenberger & Ghisletta, 2009; Manton, 1990). The relevance of physical and cognitive health for both evaluative and emotional facets of well-being in old age has long been acknowledged in conceptual and empirical work. For example, several conceptual accounts cite restriction from the external world—which induces psychological stress, social isolation, and disruption to daily routines—as a means through which poor physical and cognitive health undermine positive evaluation of life and the experience of positive emotions (Disability Hypothesis: Watson & Pennebaker, 1989; Activity Theory: Lemon, Bengtson, & Peterson, 1972; Activity Restriction Model: Williamson, 1998; see also Maier & Smith, 1999). The Strengths and Vulnerabilities Integration model (SAVI; Charles, 2010) maintains that such aging-related vulnerabilities undermine the efficacy of regulatory strategies as well as the application of accumulated experiences and skills older adults typically use to maintain positive emotions (see also Schöllgen, Morack, Infurna, Ram, & Gerstorf, 2016, for an overview). Consistent with theoretical models, empirical research has established associations between health and both evaluative and emotional well-being and have shown that health accounts for some 10% of the variance in levels of subjective well-being (for meta-analyses, see DeNeve & Cooper, 1998; Okun, Stock, Haring, & Witter, 1984). Although physical and cognitive health operate as risk factors for subjective well-being in old age, such associations are often smaller than one would expect based on the conceptual considerations noted above. Important for the purpose of the present study is that most of these studies exclusively used self-reported measures of health, which tap into different aspects than objective and functional measures of health (Baltes & Smith, 2003), likely due to the myriad of emotional and cognitive processes (e.g., disengagement, compartmentalization, dissonance) and coping strategies (e.g., avoidance, denial) that influence people's self-evaluation. As a consequence, it is an open question whether and how such associations generalize to more objective and performance-based measures of health.

The Role of Personality

Associations of extraversion and neuroticism with well-being have long been established (Heller, Watson, & Ilies, 2004; Lucas & Fujita, 2000; Soto, 2015; Specht, Egloff, & Schmukle, 2013;

Steel, Schmidt, & Shultz, 2008; Suh, Diener, & Fujita, 1996). Such associations are thought to be based on instrumental and temperamental pathways (Harris, English, Harms, Gross, & Jackson, 2017; McCrae & Costa, 1991). The instrumental perspective maintains that personality shapes proclivity to and engagement with positive life experiences, which in turn create conditions that foster satisfaction with life and positive affective experiences. For example, people high on extraversion inherently enjoy and participate in social activities, which boosts life satisfaction and positive affect. In contrast, people high on neuroticism are predisposed to create and experience stressful environments, which presumably trigger negative emotions and make them less satisfied and happy (Lucas, 2018; Lucas, Le, & Dyrenforth, 2008; McCrae & Costa, 1991; Vittersø, 2001; Wagner, Lüdtke, Roberts, & Trautwein, 2014; Watson & Clark, 1984). The temperamental perspective maintains that personality directly affects well-being by producing stable perceptions and interpretations of the objective circumstances of one's life (McCrae & Costa, 1991). Part of this perspective is rooted in behavioral activation systems research, which emphasizes the role of reward and punishment sensitivity in linking extraversion and neuroticism to well-being. Building upon Gray's (1970, 1987) theory of personality, proponents of this view argue that people high on extraversion are more sensitive to signals of reward and are therefore more likely to experience enduring positive emotions. By contrast, people high on neuroticism are more reactive to signals of punishment and negative emotional stimuli and are thus more likely to experience enduring negative emotions.

Importantly, personality and well-being associations are typically reported among young and middle-aged adults (Heller et al., 2004; Lucas & Fujita, 2000; Soto, 2015; Specht et al., 2013; Steel et al., 2008; Suh et al., 1996). In contrast, several longitudinal studies report that associations become weaker in old age when physical and cognitive health challenges faced by older adults are increasingly severe and relevant (Magee, Miller, & Heaven, 2013; Morack, Infurna, Ram, & Gerstorf, 2013; Mueller, Wagner, Wagner, Ram, & Gerstorf, 2019). From an instrumental perspective, the potential for personality to create conditions that foster satisfaction with life and positive emotions might be limited by increasing health constraints. For example, engagement in physical, cognitive, and social activities across older adulthood presumably becomes increasingly reliant on health-related functioning (Birren, 1959) and thereby reduces situational opportunities for older adults to express trait-congruent behaviors that are known to promote positive subjective well-being. For example, functional limitations, disability, or reduced mobility that prevent people high on extraversion from engaging in and seeking pleasure from social interactions may thereby diminish the power of extraversion to bring about positive emotions and life satisfaction (Withey, Gellatly, & Annett, 2005). In a similar vein, with limitations in physical health and the accompanying increased dependence on others, it becomes presumably more and more difficult for people low on neuroticism to actively select themselves into particular situations and out of others. Drawing from behavioral concordance research (Moskowitz & Coté, 1995), when people cannot behave in ways that are in accordance with their personalities, reductions in happiness and satisfaction are likely. Therefore, not only do increasing health constraints leave little room for other influences (such as personality) to operate, but these also disrupt the behavioral pathways by which personality is theorized to shape subjective well-being.

The attenuation of predictive effects of personality for subjective well-being with age highlights the importance of considering these associations in the context of increasing health challenges. In a narrative review of the literature, Dolan, Peasgood, and White (2008) emphasized the importance of controlling for various individual difference correlates of well-being, such as health, in order to achieve an accurate estimate of the nature and size of personality–well-being associations. It is therefore surprising that empirical studies investigating the role of personality for well-being have either not taken into account physical and cognitive health (e.g., Boyce, Wood, Delaney, & Ferguson, 2017; Hahn, Johnson, & Spinath, 2013; Magee et al., 2013; Schimmack, Oishi, Furr, & Funder, 2004) or have exclusively used self-reported measures (e.g., Ha & Kim, 2013; Mroczek & Spiro, 2005). Although self-report measures are unique indicators of health, relying only on self-report in the context of personality–well-being associations may be problematic because these are partly rooted in individual difference characteristics such as personality. In particular, personality traits contribute to how people perceive their health and thus do not provide information on a person's objective health. For example, neuroticism is thought to be associated with unrealistically negative perceptions of health and prompt feelings of anxiety and negative affect (Adler & Matthews, 1994; Watson & Pennebaker, 1989). Indeed, empirical studies report that personality in the latter half of life is related to subjective perceptions of health (Goodwin & Engstrom, 2002; Jokela et al., 2014; Letzring, Edmonds, & Hampson, 2014). Moving one step forward from such reports, the current study operationally defines physical and cognitive health with more objective and performance-based measures. To start with, physical health was first indexed by a morbidity checklist obtained by physicians at the Charité University Hospital and second by performance of grip strength that taps into a well-defined aspect of upper-body functioning that has repeatedly been linked with several aspects of successful aging (Ambrasat, Schupp, & Wagner, 2011). As a measure of cognitive functioning, we made use of performance on the Digit Symbol test (Wechsler, 1955) and the Symbol Correspondence Test (Lang, Weiss, Stocker, & von Rosenbladt, 2007). This is a measure of perceptual speed that is highly reliable (Lindenberger, Mayr, & Kliegl, 1993), loads highly on general intelligence (Salthouse, 1996), is more sensitive to cognitive decline in old age than many other cognitive abilities (Hoyer, Stawski, Wasylyshyn, & Verhaeghen, 2004), and has been shown to predict a number of individual functioning outcomes (e.g., day-to-day activities: Aartsen, Smits, van Tilburg, Knipscheer, & Deeg, 2002; cardiovascular liability: Ram, Gerstorf, Lindenberger, & Smith, 2011; and mortality: Bosworth, Schaie, & Willis, 1999).

Health by Personality Interactions

It stands to reason that personality dimensions buffer or exacerbate the deleterious effects of poor physical and cognitive health for well-being and emotions in old age (Costa & McCrae, 1980; Friedman, 2000; McCrae & Costa, 1991; Smith, 2006). From an instrumental perspective, high extraversion and low neuroticism both contribute to an individual's motivation and ability to engage in and pursue health-relevant behaviors (Chapman, Roberts, &

Duberstein, 2011; Mõttus et al., 2013; Rhodes & Smith, 2006) and socially rewarding experiences (Okun, Pugliese, & Rook, 2007; Selfhout et al., 2010) that may help to alleviate the consequences of health challenges. From a temperamental perspective, it is known that extraversion and neuroticism shape the way in which people perceive their health (e.g., high extraversion and low neuroticism are associated with unrealistically positive appraisals of health: Jokela et al., 2014; Letzring et al., 2014). As a consequence the strength of impact that poor health has on one's well-being may also be shaped by one's perception and interpretation of such circumstances.

It is also possible that effects of personality may reverse with increasing health challenges (for in-depth discussion, see Mueller, Wagner, & Gerstorf, 2017). For example, older adults maintain well-being by being more cognizant of threats to one's health—a scenario in which higher levels of neuroticism are associated with higher well-being (Baltes & Baltes, 1990; Heckhausen, Wrosch, & Schulz, 2010). The increasing number of threats in old age may trigger the behavioral inhibition system of people high in neuroticism and so allow them to proactively avoid age-related stressors that are difficult to cope with. In a similar vein, extraversion may become increasingly disadvantageous because increasing health challenges that restrict people's ability to engage in and derive pleasure from social activities (Carver, Sutton, & Scheier, 2000) may contribute to lower well-being (Kette, 1991). Initial empirical evidence for these conceptual arguments comes from a recent study demonstrating that physical health and social factors interact with personality to shape terminal decline trajectories in well-being (Mueller et al., 2019). In the current study, we broaden the perspective considerably by moving from the unique terminal decline phase at the very final years of life to considering the many different decades of life that constitute old age.

The Present Study

We apply parallel sets of growth models to multiyear, within-person change data obtained in BASE-II (N = 1,216; M_{age} = 71 years; range 60–88; 51% women) and SOEP (N = 3,418; M_{age} = 70 years; range 60–100; 51% women). We specifically ask (a) how central facets of subjective well-being (life satisfaction, morale; feeling happy, angry, fearful, and sad) change as people move through old age, (b) whether and how key indicators of physical and cognitive health (overall morbidity, performance-based measures of grip strength and perceptual speed) and personality (extraversion and neuroticism) uniquely predict such trajectories, and (c) whether health and personality interact in these predictions.

We expect average stability or increase in the evaluative and positive emotion facets of well-being and average stability or decline in the discrete negative emotions (sad, angry, fearful), and we expect that these are also characterized by substantial individual differences in levels and rates of change. We hypothesize that higher levels of overall morbidity and of extraversion as well as lower levels of grip strength, perceptual speed, and neuroticism will each be independently associated with lower well-being across old age. Because extraversion and neuroticism are often defined as the propensity to experience positive emotions and negative emotions, respectively, we expect extraversion and neuroticism to show the strongest association with these two sets of emotions. Because expectations are less clear, we largely explore how health and personality uniquely predict subjective well-being change and whether personality and health interactively shape well-being and emotion trajectories.

Method

Data were drawn from the Berlin Aging Study 2 (BASE-II) and the German Socio-Economic Panel (SOEP). A detailed description of the BASE-II and SOEP study design, sampling methods, variables, and procedures can be found in Bertram et al. (2014) and Gerstorf et al. (2016) for BASE-II and in Goebel et al. (2018) for SOEP. Select details relevant for the current study are presented below.

Participants and Procedure

For BASE-II, participants were recruited from 2008 to 2013 from the metropolitan area of Berlin via advertisements as well as a participant pool at the Max Planck Institute for Human Development. Personality measures were obtained as part of a larger psychosocial assessment battery (see Gerstorf et al., 2015). Most participants completed the questionnaire online or at home with a paper–pencil version. Less than 5% of participants answered the items in face-to-face interviews. Medical information was obtained by the Charité - Universitätsmedizin Berlin as part of a two-day medical assessment that included a wide range of laboratory and functional tests as well as a comprehensive medical history assessment (see König et al., 2018). Cognitive assessments were administered in the laboratory in group sessions of three to six participants (Düzel et al., 2016). One wave of personality data (assessed in 2009) and one wave of health data were available for this study. Approximately 80% of participants completed their health assessment between waves two (2009) and three (2012), and the remaining 20% of participants completed the assessment after wave three.[1]

Through survey questionnaires, up to eight waves of life satisfaction (assessed in 2008, 2009, 2010, 2012, 2013, 2014, 2016, and 2018) data and three waves of psychological morale (assessed in 2012, 2014, and 2016) data were obtained. Included in analyses were all BASE-II participants aged 65 or older who provided at least one well-being assessment, resulting in a final sample of 1,216 participants aged 60–88 (M_{age} = 71; SD_{age} = 3.48; 51% women). Specifically, we have 86% (n = 809) of participants who provided at least four measurement points for life satisfaction and 92% (n = 1,060) of participants who provided at least three measurement points for psychological morale.

For SOEP, participants were randomly recruited residents of Germany (for the random-walk recruitment methodology, see Thompson, 2006). The SOEP is a nationally representative prospective annual multicohort study of individuals in private households. SOEP has covered approximately 50,000 residents of Germany since it began in 1984. Data are collected once per year and

[1] To make sure that our results are not influenced by the different timing of health assessments, we included the date of the health assessment as an additional predictor in follow-up analyses. This did not affect the pattern of results. In follow-up analyses, we additionally estimated the models with only the participants who had completed the health assessment between wave two and three and only used well-being data that were collected after these health assessments, which left us with five waves of life satisfaction data and three waves of psychological morale data. A small number of health effects did not remain statistically significant (for details, see Online Supplementary Material C, Table C1).

primarily through face-to-face interviews, with approximately 10% of long-term participants responding via self-administered mail questionnaires. For this study, we analyzed eight waves of life satisfaction and affective well-being data (assessed in 2009, 2010, 2011, 2012, 2013, 2014, 2015 and 2016), one wave of personality data (assessed in 2009) and one wave of health data (assessed in either 2008 or 2009). Included in our analyses were all participants aged 60 or older who provided at least one well-being assessment, resulting in a final sample of 3,418 participants aged 60–100 (M_{age} = 70; SD_{age} = 4.87; 51% women). With this set-up, we have 83% (*ns* between 3,443 and 8,472) of participants who provided at least six measurement points for each of the well-being and emotion measures used.

Ethics approval for BASE-II was granted by the ethics committee of the Charité – Universitätsmedizin Berlin and the ethics committee of the Max Planck Institute for Human Development, Berlin. Data from BASE-II have been used in a comprehensive number of publications covering a variety of research questions (see https://www.base2.mpg.de/en for a list of publications). Sociodemographics, physical and cognitive health, and psychosocial variables from the BASE-II data have been extensively used in psychological research (e.g., Düzel et al., 2016; Gerstorf et al., 2015; Hülür et al., 2016; König et al., 2018; Mueller et al., 2016), but the research questions examined here do not overlap with any of these reports.

Ethics approval for the SOEP was granted by the German Council of Science and Humanities (Wissenschaftsrat). In addition, the SOEP is approved as being in accordance with the standards of the Federal Republic of Germany for lawful data protection; all participants gave free and informed consent to participate in the survey. A wide variety of research questions have been examined using SOEP data in a number of previous publications (see http://www.diw.de/soeppapers for a list of publications). Note that prior studies from our group have investigated psychosocial and physical health predictors of terminal well-being decline (i.e. among decedents only: Gerstorf et al., 2014, 2016; Mueller et al., 2019). Moving one step further, the current study is the first to examine old age more broadly and investigate the unique and interactive roles of physical health and personality for levels and change across a number of different measures of subjective well-being.

To quantify sample selection and attrition, we conducted two sets of selectivity analysis. First, we examined whether and how participants included in our analyses were different from those who had not been included (e.g., because of missing data on any of the relevant variables). Results revealed that BASE-II participants included in our subsample were younger at first assessment (d = −0.22) and had better perceptual speed (d = 0.07) than those not included ($n \approx 200$) but did not differ in terms of demography and personality. For SOEP, participants in our sample were younger, included more females (d = −0.03), were more educated (d = 0.22), had lower morbidity (d = −0.14), higher grip strength (d = 0.24), higher perceptual speed (d = 0.44), and were less neurotic (d = −0.04) and more extraverted (d = 0.04), open (d = 0.131) and conscientious (d = 0.08) than the 60+ year old SOEP participants not included here ($n \approx 350$). Second, we used an effect-size metric indicating the extent to which individuals who provided data at only wave one differed from those who contributed more than one wave of data (for details, see Lindenberger, Singer, & Baltes, 2002). For BASE-II, the latter were older (d = 0.28), but did not differ in terms of demography, physical or cognitive health, and personality. For SOEP, participants who contributed more than one wave of data were younger (d = −0.14) and better educated (d = 0.08) and had lower morbidity (d = −0.05), stronger grip strength (d = 0.08), higher perceptual speed (d = 0.14,) and more openness (d = 0.05). Results by and large indicate that participants included in our analyses (particularly those who provided the most change information) represent a positively selected subset of the larger population. Our results may thus not generalize to more diverse and frail population segments.

Measures

Subjective well-being. All well-being and affect measures were assessed longitudinally. In both BASE-II and SOEP, life satisfaction was assessed with the question "How satisfied are you with your life, all things considered?" (translation of "Wie zufrieden sind Sie gegenwärtig, alles in allem, mit ihrem Leben?"; see also Fujita & Diener, 2005; Headey, Muffels, & Wagner, 2010), answered on a 0 (*totally unsatisfied*) to 10 (*totally satisfied*) scale. Responses are taken as an indication of evaluative aspects of well-being (Diener, Suh, Lucas, & Smith, 1999). Psychological morale was only assessed in BASE-II using three items from the Philadelphia Geriatric Center Morale Scale (Lawton, 1975) rated on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*). Responses to the items ("I sometimes feel that life isn't worth living"; "I have a lot to be sad about"; "I take things hard") were reverse-coded so that higher scores indicate higher morale. Affective experiences—feeling happy, angry, fearful, and sad—were assessed using single items ("In the last four weeks, how often have you felt . . .?"), answered on a five-point scale ranging from 1 (*very rarely*) to 5 (*very often*; see Hudson, Lucas, & Donnellan, 2016). These four items measuring affective experiences have been widely used in psychological and life span developmental inquiry (e.g., Anusic, Lucas, & Donnellan, 2017; Kunzmann, Richter, & Schmukle, 2013).

Physical and cognitive health. In BASE-II, overall morbidity was obtained through participant self-reports of diagnoses, with select diagnoses (e.g., diabetes mellitus) being verified by additional (blood-laboratory) tests (for details, see Bertram et al., 2014). Diagnoses were used to compute a morbidity index largely based on the categories of the Charlson index, which is a weighted sum of moderate to severe diagnoses, mostly of chronic physical illnesses, including cardiovascular illnesses (e.g., congestive heart failure), cancer (e.g., lymphoma), and metabolic diseases (e.g., diabetes mellitus). Each disease was assigned a number (1 = *moderate* to 3 = *severe*) based on the severity of the condition (e.g., 1 for myocardial infarct, diabetes, ulcer or chronic liver disease; 2 for diabetes with end organ damage, tumor, or lymphoma; 3 for moderate or severe liver disease, etc.; for details, see Charlson, Pompei, Ales, & MacKenzie, 1987; Meyer et al., 2016). In the SOEP, morbidity was defined as the number of medical conditions participants endorsed on a nine-category medical symptom checklist (diabetes, asthma, cardiopathy, cancer, apoplectic stroke, high blood pressure, migraine, dementia, and other chronic illnesses).

In BASE-II, grip strength was assessed as the average force applied to a hand dynamometer (Smedley) over three trials with the dominant hand (for details, see Goldeck et al., 2016). The force exerted was measured in kilograms (0–100 kg). In the SOEP, grip strength was similarly assessed as the average force applied to

hand dynamometer (Smedley S TTM Tokio 100kg), over two trials with the dominant hand (for details, see Ambrasat et al., 2011).

In BASE-II, the Digit Symbol subtest of the Wechsler Adult Intelligence Test (WAIS; Wechsler, 1955) was used to assess perceptual speed. The test involves substituting symbols for numbers following a coding scheme. Participants were given 90 s to fill as many boxes as possible with the appropriate symbols. The score was then calculated by subtracting the number of errors from the number of correctly filled boxes (for details, see Gerstorf et al., 2015). In the SOEP, perceptual speed was assessed by the Symbol Correspondence Test—an ultrashort test developed for the SOEP (for details, see Lang et al., 2007) that corresponds to the Digit Symbol subtest of the WAIS. The test similarly involved participants matching as many numbers and symbols as possible within 90 s according to a given correspondence list which is visible to the respondents on a screen. The test shows considerable convergent validity with more comprehensive and well-established intelligence tests (Lang et al., 2007).

Personality. In both BASE-II and SOEP, personality was assessed using a German short version of the Big Five Inventory (BFI-S; John & Srivastava, 1999; Lang, John, Lüdtke, Schupp, & Wagner, 2011). The scale used contains three items for each of the five factors (extraversion, neuroticism, conscientiousness, openness, agreeableness) and were answered on a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The scale was designed for use in large surveys and displays acceptable reliability and validity in comparison with the German adaption of the NEO-FFI and other criteria (Gerlitz & Schupp, 2005). In both samples, Cronbach's alphas for the two subscales were at the lower end of what is considered acceptable (BASE-II: neuroticism $\alpha = .70$, extraversion $\alpha = .69$; SOEP: neuroticism, $\alpha = .60$; extraversion $\alpha = .60$), which reflects the shortness of the scales and the heterogeneity of the items that were selected to measure relatively broad constructs (for more details, see Lucas & Donnellan, 2011).

Demographic correlates. For both BASE-II and SOEP, we used the same set of demographic variables. For both data sets, age was computed as the difference between the date of a participant's personality assessment and his or her date of birth, scaled in years. Gender was coded 0 for men and 1 for women. Education was measured as number of years spent in formal schooling.

Statistical Analyses

To ensure comparability, we used the same set of multilevel growth models for each well-being and emotion outcome variable. To investigate our research questions, we estimated multilevel growth models using repeated measures of well-being over time. Our basic model took the following form:

$$Well-being_{ti} = \beta_{0i} + \beta_{1i}(time_{ti}) + \beta_{2i}(time^2_{ti}) + e_{ti} \quad (1)$$

where person *i's* subjective well-being at time *t*, well-being$_{ti}$, is modeled as a function of an individual-specific intercept parameter, β_{0i}, and individual-specific slope parameters, β_{1i} and β_{2i}, that model linear and quadratic rates of change in well-being over time and residual error, e_{ti}. Following usual practice (Ram & Grimm, 2015), we modeled individual differences in intercepts, β_{0i}, and slopes, β_{1i} and β_{2i} (from the Level 1 model given in Equation 1), as a function of health and personality variables and their interaction, as well as age interactions (Level 2). For all subjective well-being outcomes, the Level 2 portion of the model took the following general form:

$$\begin{aligned}\beta_{0i} = {} & \gamma_{00} + \gamma_{01}(age\ at\ T1_i) + \gamma_{02}(women_i) + \gamma_{03}(education_i) \\ & + \gamma_{04}(morbidity_i) + \gamma_{05}(grip\ strength_i) \\ & + \gamma_{06}(perceptual\ speed_i) + \gamma_{07}(extraversion_i) \\ & + \gamma_{08}(neuroticism_i) + \gamma_{09}(extraversion_i \times health\ variable_i) \\ & + \gamma_{010}(neuroticism_i \times health\ variable_i) \\ & + \gamma_{011}(personality_i \times age\ at\ T1_i) \\ & + \gamma_{012}(personality_i \times health\ variable_i \times age\ at\ T1_i) + u_{0i},\end{aligned} \quad (2)$$

$$\begin{aligned}\beta_{1i} = {} & \gamma_{10} + \gamma_{11}(age\ at\ T1_i) + \gamma_{12}(women_i) + \gamma_{13}(education_i) \\ & + \gamma_{14}(morbidity_i) + \gamma_{15}(grip\ strength_i) \\ & + \gamma_{16}(perceptual\ speed_i) + \gamma_{17}(extraversion_i) \\ & + \gamma_{18}(neuroticism_i) + \gamma_{19}(extraversion_i \times health\ variable_i) \\ & + \gamma_{110}(neuroticism_i \times health\ variable_i) \\ & + \gamma_{111}(personality_i \times age\ at\ T1_i) \\ & + \gamma_{112}(personality_i \times health\ variable_i \times age\ at\ T1_i) + u_{1i},\end{aligned} \quad (3)$$

$$\beta_{2i} = \gamma_{19} + u_{2i}. \quad (4)$$

where γ_{00} to γ_{112} are sample-level regression parameters and the u_{0i} through u_{2i} are residual unexplained individual differences, which are assumed to be multivariate normally distributed with variances $\sigma^2_{u_{0i}}$, $\sigma^2_{u_{1i}}$ and $\sigma^2_{u_{2i}}$, and covariance $\sigma^2_{u_{0i}u_{1i}}$, $\sigma^2_{u_{0i}u_{2i}}$ and $\sigma^2_{u_{0i}u_{2i}}$. All person-level predictors were grand-mean centered, so that the regression parameters reflect average trajectories across all individuals. Age was centered at 70 years because this is the age range for which most observations are available and thus help the models to produce more robust parameter estimates. Following good practice (Grimm, Ram, & Estabrook, 2016), the final models were trimmed to remove main effects on the slope, interaction terms and quadratic slopes that were not reliably different from zero.

We fitted all models to the data using SAS Proc Mixed (Littell, Milliken, Stroup, Wolfinger, & Schabenberger, 2006) with the typical assumption that incomplete data were missing at random (Little & Rubin, 1987). Variables included in our models (e.g., age, gender, education, and health) served as attrition-informative variables that help to accommodate longitudinal selectivity (Grimm et al., 2016; McArdle, 1994). Research into interaction effects of health and personality for older adults' subjective well-being is still underexplored, making it potentially important to allow even small effects to surface. Therefore, rather than adjusting for multiple testing in highly conservative ways, we chose the more liberal $p < .05$ significance level to give personality the chance to emerge as a moderator.

Results

Observed means, standard deviations, and intercorrelations among the study variables are presented in Table 1 (BASE-II sample) and Table 2 (SOEP sample). As expected, all facets of subjective well-being showed small, and mostly significant, cor-

Table 1
Descriptive Statistics and Intercorrelations Among the Study Variables in BASE-II

Variable	Intercorrelations									
	1	2	3	4	5	6	7	8	9	10
1. Life satisfaction (0–10)	1	.44	−.02	−.04	.03	−.11	.08	.04	−.34	.19
2. Morale (0–4)		1	−.03	−.10	.08	−.12	.12	.09	−.47	.16
3. Age (60–88)			1	.02	−.02	−.00	−.12	−.10	.03	−.10
4. Women (0, 1)				1	−.19	−.04	−.79	.16	.16	.14
5. Education (7–18)					1	.01	.16	.13	−.03	−.08
6. Morbidity (0–10)						1	−.04	−.06	.13	−.01
7. Grip strength (7–59)							1	−.10	−.19	−.08
8. Perceptual speed (21–76)								1	−.07	−.05
9. Neuroticism (1–7)									1	−.14
10. Extraversion (1–7)										1
M	7.61	3.08	70.62	0.51	14.59	1.25	32.28	44.35	3.58	4.95
SD	1.62	0.83	3.84	0.50	3.02	1.32	9.14	8.95	1.31	1.17

Note. N = 1,216. Intercorrelations of $r = |.08|$ or above differ statistically significantly from zero at $p < .01$.

relations with morbidity (ranging between $r = .10$ and .19), grip strength (ranging between $r = .01$ and .25), and perceptual speed (ranging between $r = .02$ and .13). These results align with the modest health–well-being associations reported in the literature (Diener & Chan, 2011; Steptoe, Demakakos, de Oliveira, & Wardle, 2012). Each facet of subjective well-being showed significant and small-to-moderate associations with extraversion (ranging between $r = .11$ and .19) and moderately sized associations with neuroticism (ranging between $r = .24$ and .47). Of note is also that intercorrelations among the health and personality predictors were in the small to moderate range, indicating that these variables tap into different aspects of the larger construct and measurement space.

Trajectories of Subjective Well-Being in Old Age

In a preliminary step, we estimated an unconditional intercept-only model for all subjective well-being outcomes in order to examine the distribution of between-person and within-person variation (see Table 3). Analyses revealed approximately even distribution of between-person variance to within-person variance for all outcomes, which helps to ensure between- and within-study comparability of results.

Consistent with previous reports (Costa, McCrae, & Zonderman, 1987; Stacey & Gatz, 1991), our results revealed that facets of negative emotions exhibited on average small but significant declines across time: feeling angry ($\gamma = -0.016$, $p = .0129$), fearful ($\gamma = -0.025$, $p < .0001$), and sad ($\gamma = -0.023$, $p = .0009$). In contrast, feeling happy ($\gamma = -0.005$, $p = .3405$) and psychological morale ($\gamma = -0.017$, $p = .2115$) exhibited average stability. Life satisfaction in BASE-II exhibited very minor declines ($\gamma = -0.021$, $p = .0139$) and in the SOEP very minor increases ($\gamma = 0.038$, $p = .0010$) (see Figure 1). As shown in the online supplementary material (see Table B1), these patterns of results remained when tested in a zero-order fashion.

Table 2
Descriptive Statistics and Intercorrelations Among the Study Variables in SOEP

Variable	Intercorrelations												
	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Life satisfaction (0–10)	1	−.28	−.32	−.36	.42	−.02	−.04	.15	−.19	.10	.13	−.34	.19
2. Angry (1–5)		1	.34	.32	−.16	−.13	.02	.01	.10	−.01	−.02	.34	−.03
3. Fearful (1–5)			1	.49	−.22	.02	.23	−.12	.12	−.22	−.08	.46	−.11
4. Sad (1–5)				1	−.29	.06	.21	−.10	.15	−.25	−.11	.40	−.11
5. Happy (1–5)					1	−.09	−.05	.11	−.10	.13	.07	−.24	.18
6. Age (60–100)						1	.05	−.13	.17	−.30	−.26	−.00	−.05
7. Women (0, 1)							1	−.22	.02	−.74	−.03	.22	.06
8. Education (7–18)								1	−.07	.21	.19	−.15	.05
9. Morbidity (0–7)									1	−.13	−.10	.17	−.03
10. Grip strength (3.5–67.5)										1	.15	−.21	.02
11. Perceptual speed (0–54)											1	−.07	.07
12. Neuroticism (1–7)												1	−.15
13. Extraversion (1–7)													1
M	7.06	2.44	1.88	2.29	3.31	69.75	0.51	11.94	1.26	35.23	20.22	3.86	4.65
SD	1.71	0.97	0.97	1.00	0.88	6.89	0.50	2.77	1.09	11.28	10.71	1.23	1.08

Note. N = 3,418. SOEP = German Socio-Economic Panel. All variables are taken from T2 (2009), the wave in which most data points had been obtained, other than psychological morale, for which a measure was only available from 2012. Intercorrelations of $r = |.08|$ or above differ statistically significantly from zero at $p < .01$.

Table 3
Baseline (Intercept-Only) Model for All Subjective Well-Being Outcomes

Effects	Life satisfaction (BASE-II)	Morale (BASE-II)	Life satisfaction (SOEP)	Angry (SOEP)	Fearful (SOEP)	Happy (SOEP)	Sad (SOEP)
Intercept *(SD)*	7.643 (0.040)**	3.066 (0.021)**	6.989 (0.019)**	2.430 (0.001)**	1.962 (0.010)**	3.322 (0.009)**	2.388 (0.010)**
Var. intercept *(SD)*	1.549 (0.081)	0.404 (0.023)	2.220 (0.042)	0.365 (0.009)	0.464 (0.011)	0.400 (0.009)	0.459 (0.011)
Residual *(SD)*	1.488 (0.035)	0.293 (0.012)	1.156 (0.003)	0.535 (0.005)	0.502 (0.004)	0.388 (0.003)	0.577 (0.005)
Rho (ICC)	0.510	0.580	0.510	0.406	0.480	0.508	0.404
AIC	17430.9	5554.6	709497.1	84307.8	83431.7	75324.1	87554.3
−2 LL	17424.9	5548.6	709491.1	84301.8	83425.7	75318.1	87548.3

Note. –2LL = −2 log likelihood; *SD* = standard deviation; ICC = intraclass correlation; Var. = variance; SOEP = German Socio-Economic Panel.
** $p < .001$.

The Role of Health and Personality

Consistent with expectations, results revealed that suffering from morbidity and poor performance on grip strength and perceptual speed were independently associated with lower levels of life satisfaction, morale, and happiness and more sadness, anger, and fear at age 70. As shown in Table 4, higher morbidity was associated with lower life satisfaction (BASE-II: $\gamma = -0.087$, $p = .0024$; SOEP: $\gamma = -0.123$, $p = .0086$) and morale ($\gamma = -0.041$, $p = .0077$), as well as more sadness ($\gamma = 0.102$, $p = .0006$) and anger ($\gamma = 0.076$, $p = .0051$). Lower grip strength was similarly associated with lower life satisfaction (BASE-II: $\gamma = -0.017$, $p = .0091$; SOEP: $\gamma = -0.029$, $p < .0001$) and happiness ($\gamma = -0.015$, $p = .0002$), as well as more sadness ($\gamma = 0.014$, $p = .0013$), fearfulness ($\gamma = 0.014$, $p = .0004$), and anger ($\gamma = 0.009$, $p = .0324$). Lower perceptual speed was associated with lower life satisfaction (SOEP: $\gamma = -0.010$, $p = .0250$), morale ($\gamma = -0.006$, $p = .0060$), and happiness ($\gamma = -0.007$, $p = .0075$) as well as more fearfulness ($\gamma = 0.008$, $p = .0024$).

Most important for our second research question, results revealed that over and above physical and cognitive health, extraversion and neuroticism were associated with individual differences in levels of well-being. As can be seen in Figure 2, higher extraversion was associated with higher life satisfaction (BASE-II: $\gamma = 0.194$, $p < .0001$; SOEP: $\gamma = 0.192$, $p < .0001$), morale ($\gamma = 0.078$, $p < .0001$), happiness ($\gamma = 0.122$, $p <$

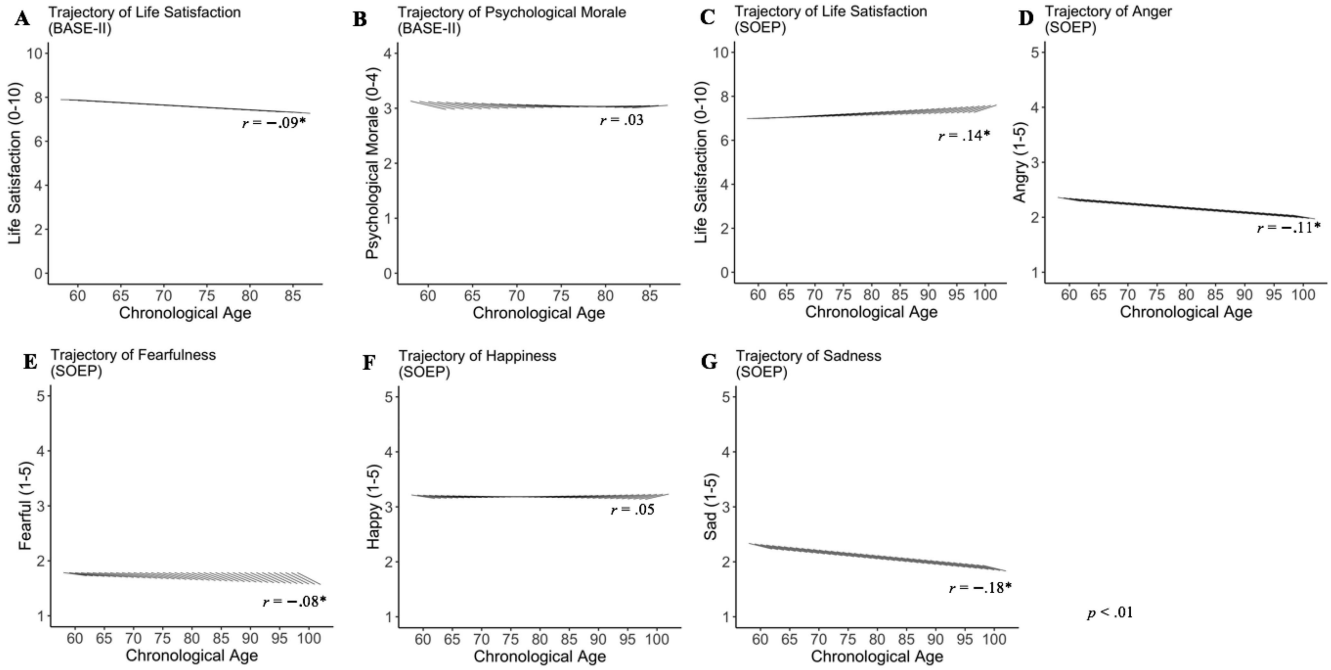

Figure 1. Prototypical model-implied well-being and emotion trajectories based on zero-order models. Short thick lines represent within-person change across chronological age. It can be obtained that well-being across old age entails both stability and change, with some facets of well-being remaining on average relatively stable (Panel B: morale; Panel F: happiness), while others exhibited slight increases (Panel C: SOEP life satisfaction) or decreases (Panel A: BASE-II life satisfaction; Panel G: sadness; Panel D: anger; Panel E: fearfulness). SOEP = German Socio-Economic Panel. $p < .01$.

Table 4
Growth Models for Well-Being, Testing Predictive Effects of Sociodemographic Characteristics, Morbidity, Grip Strength, and Perceptual Speed

Effects	Life satisfaction (BASE-II)		Morale (BASE-II)		Life satisfaction (SOEP)	
	Est.	*SE*	Est.	*SE*	Est.	*SE*
Intercept	7.652**	0.040	3.045**	0.025	7.147**	0.064
Slope	−0.021*	0.008	−0.017	0.014	0.040**	0.011
Slope^2	−0.005*	0.002	—	—	—	—
Age	0.020	0.011	0.000	0.005	0.017*	0.007
Women	0.198	0.123	−0.075	0.067	0.709**	0.149
Education	0.006	0.012	0.010	0.007	0.063*	0.019
Morbidity	−0.087*	0.029	−0.041*	0.015	−0.122*	0.049
Grip strength	0.017*	0.007	0.002	0.004	0.029**	0.007
Perceptual speed	0.008	0.004	0.006*	0.002	0.011*	0.005
Extraversion	0.194**	0.033	0.078**	0.018	0.191**	0.045
Neuroticism	−0.361**	0.030	−0.273**	0.016	−0.387**	0.040
Age × Slope	0.003	0.002	0.001	0.004	0.002	0.002
Women × Slope	0.038	0.027	−0.030	0.052	−0.044	0.035
Education × Slope	0.003	0.003	0.003	0.005	−0.001	0.004
Morbidity × Slope	−0.009	0.006	−0.029*	0.013	0.016	0.011
Grip × Slope	0.001	0.001	−0.003	0.003	−0.003	0.002
Speed × Slope	−0.001	0.001	0.002	0.002	−0.001	0.001
Extraversion × Slope	−0.001	0.007	−0.020	0.013	0.011	0.009
Neuroticism × Slope	−0.004	0.006	0.015	0.012	−0.011	0.009
Extraversion × Age	−0.017	0.009	—	—	—	—
Speed × Age	0.000	0.001	—	—	—	—
Extraversion × Speed	−0.003	0.001	—	—	−0.009*	0.004
Extraversion × Speed × Age	−0.003*	0.001	—	—	—	—
Neuroticism × Morbidity	−0.025	0.022	—	—	—	—
Neuroticism × Age	−0.009	0.008	—	—	—	—
Morbidity × Age	−0.000	0.008	—	—	—	—
Neuroticism × Morbidity × Age	0.015*	0.006	—	—	—	—
Variance intercept	0.168	0.074	0.228	0.016	2.529	0.142
Variance slope	0.016	0.003	—	—	0.067	0.005
Variance slope^2	0.001	0.000	—	—	—	—
Cov. intercept, slope	0.008	0.010	—	—	0.266	0.021
Cov. intercept, slope^2	−0.001	0.003	—	—	—	—
Cov. slope, slope^2	−0.002	0.001	—	—	—	—
Residual variance	1.281	0.041	0.290	0.012	0.913	0.007

Note. $N_{\text{BASE-II}}$ = 1,208; N_{SOEP} = 3,472; Grip = grip strength; speed = perceptual speed; SOEP = German Socio-Economic Panel.
^{2} indicates a quadratic variable/association
* $p < .05$. ** $p < .001$.

.0001), as well as with less fear ($\gamma = -0.082$, $p = .0014$). No associations were found with sadness and anger. Higher neuroticism was associated with all facets of well-being: lower life satisfaction (BASE-II: $\gamma = -0.361$, $p < .0001$; SOEP: $\gamma = -0.388$, $p < .0001$), morale ($\gamma = -0.273$, $p < .0001$), and happiness ($\gamma = -0.120$, $p < .0001$,) as well as more sadness ($\gamma = 0.251$, $p < .0001$), fearfulness ($\gamma = 0.285$, $p < .0001$), and anger ($\gamma = 0.202$, $p < .0001$). Our models revealed very few predictive effects of health and personality for change in well-being. As shown in the online supplementary material (see Tables 3A and 4A) the remaining Big Five personality traits—conscientiousness, agreeableness and openness—showed much more facet-specific relations with levels of well-being and also showed very few relations with change trajectories.

Health by Personality Interactions

Results revealed a small number of interaction effects between indicators of health and personality for level and change in affective experiences, but not for life satisfaction or morale. As shown in Table 5, interactions between neuroticism and grip strength were particularly relevant to affective experiences: Neuroticism moderated the association between grip strength and fearfulness ($\gamma = -0.006$, $p = .0001$) and between grip strength and happiness ($\gamma = 0.004$, $p = .0345$), as well as between grip strength and change in anger ($\gamma = 0.001$, $p = .0089$) and change in sadness ($\gamma = 0.001$, $p = .0231$). These results suggest that better grip strength buffers the consequences of high neuroticism for level and declines in affective well-being. They also indicate that low neuroticism is particularly beneficial for people's levels of affective experiences at age 70, whereas high neuroticism may act to strengthen declines in anger and sadness.

Interactions between extraversion and indicators of health were detected for fearfulness and happiness. In particular, extraversion moderated the association between morbidity and fear ($\gamma = -0.047$, $p = .0219$), between grip strength and change in fear

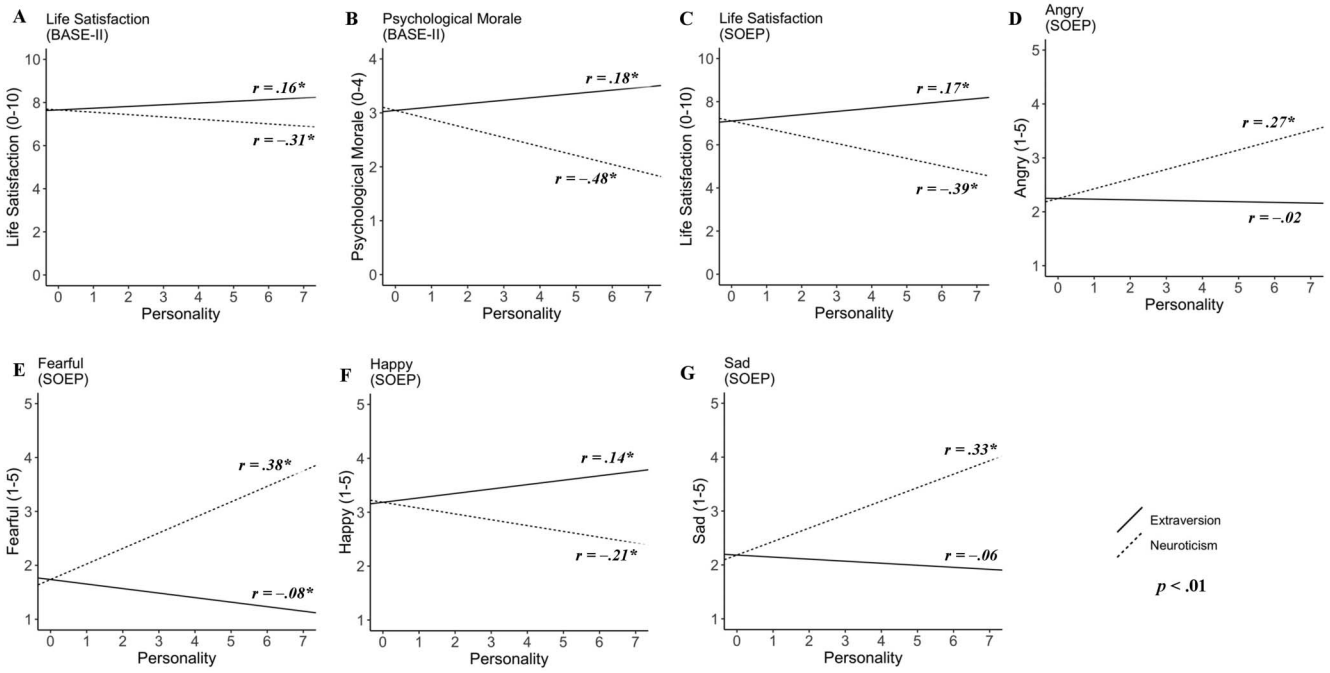

Figure 2. Illustrating level associations of extraversion (solid line) and neuroticism (dotted line) with well-being. It can be obtained that higher neuroticism was associated with lower well-being across all facets of well-being (Panel A: life satisfaction BASE-II; Panel B: morale; Panel C: life satisfaction SOEP; Panel D: anger; Panel E: fear; Panel F: happy; Panel G: sad), while higher extraversion was associated with better well-being in all facets but sad and angry. SOEP = German Socio-Economic Panel. $p < .01$.

across time ($\gamma = -0.001$, $p = .0460$), and between perceptual speed on level of ($\gamma = -0.005$, $p = .0245$) and change in ($\gamma = -0.001$, $p = .0073$) happiness. These results suggest that in the context of poor physical and cognitive functioning, higher levels of extraversion are protective for levels of happiness and fear at age 70 as well as changes in happiness but act as a risk factor for changes in fear across time. Nonetheless, it is important to interpret these results with caution, given that the effects were small in size and not consistent across studies. Very few personality–health interactions were detected for life satisfaction and morale, with the few that were detected not being corroborated across study.

Discussion

The major objective of the current study was to examine the role of health and personality as two key sets of individual difference characteristics as unique and interactive predictors of levels and trajectories of a number of central facets of subjective well-being. To do so, we made use of two large-scale longitudinal data sets, the BASE-II and SOEP. Our results revealed average stability of all facets across old age. Consistent with prior research, we found that suffering from morbidity and poor performances on grip strength and perceptual speed were independently associated with reporting lower life satisfaction, morale, and happiness as well as feeling more anger, fear, and sadness at age 70 (DeNeve & Cooper, 1998; Isaacowitz & Smith, 2003; Okun et al., 1984). Over and above such associations with poor physical and cognitive health, extraversion and neuroticism continued to be unique and consistent predictors of facets of subjective well-being. In contrast, evidence for differential change associations was rare and facet-specific. Some evidence emerged for the proposal that personality and aspects of health interact to predict trajectories of well-being and emotion in old age, but such effects were observed only for affective experiences and not for life satisfaction or morale, were not consistent across studies, and were very small in size. We discuss theoretical and practical implications.

The Role of Physical and Cognitive Health

Our results are in line with and corroborate conceptual notions and earlier empirical reports of average stability in facets of evaluative well-being and minor increases in affective well-being across old age (Charles et al., 2001; Diener et al., 2009). That happiness showed mean-level stability while the negative emotions (sad, fearful, angry) slightly declined with advancing age is consistent with theories of enhanced emotion regulation abilities (Carstensen, 2006) as well as with past reports that decreases in negative affect occur across the entire adult range of years, whereas decreases in positive affect occur only among the old-old (Costa et al., 1987; Stacey & Gatz, 1991). Taken together, these results are consistent with central tenets of lifespan developmental theory (gains and losses, multidirectionality, intraindividual change; Baltes, 1987) and point to the importance of treating well-being as a multidimensional and multidirectional set of constructs.

Table 5
Growth Models for Emotions, Testing Predictive Effects of Sociodemographic Characteristics, Morbidity, Grip Strength, and Perceptual Speed

Effects	Angry (SOEP)		Fearful (SOEP)		Happy (SOEP)		Sad (SOEP)	
	Est.	*SE*	Est.	*SE*	Est.	*SE*	Est.	*SE*
Intercept	2.260**	0.040	1.733**	0.039	3.199**	0.036	2.188**	0.046
Slope	−0.016*	0.006	−0.025**	0.005	−0.005	0.005	−0.023**	0.007
Slope^2	—	—	—	—	—	—	—	—
Age	−0.021**	0.004	−0.002	0.004	−0.008*	0.004	0.003	0.005
Women	−0.222*	0.086	0.048	0.085	0.229*	0.083	0.084	0.095
Education	0.035*	0.011	0.010	0.012	0.028	0.010	0.016	0.012
Morbidity	0.076*	0.027	0.014	0.027	−0.005	0.026	0.102**	0.030
Grip strength	−0.009*	0.004	−0.014**	0.004	0.015*	0.004	−0.014*	0.004
Perceptual speed	−0.005	0.003	−0.008**	0.003	0.007*	0.003	−0.004	0.003
Extraversion	0.012	0.026	−0.082*	0.025	0.122**	0.025	−0.030	0.028
Neuroticism	0.202**	0.023	0.285**	0.023	−0.120**	0.022	0.251**	0.025
Age × Slope	0.001	0.001	−0.000	0.001	0.001	0.001	−0.002	0.001
Women × Slope	−0.020	0.020	−0.029	0.019	0.021	0.017	−0.029	0.022
Education × Slope	0.004	0.002	−0.000	0.002	0.004	0.002	0.004	0.003
Morbidity × Slope	0.012	0.006	−0.002	0.006	−0.004	0.005	0.011	0.007
Grip × Slope	0.001	0.001	−0.001	0.001	−0.000	0.001	−0.001	0.001
Speed × Slope	−0.001	0.001	0.001	0.001	−0.000	0.001	0.001	0.001
Extraversion × Slope	−0.002	0.006	−0.015*	0.006	0.013*	0.005	−0.007	0.007
Neuroticism × Slope	−0.003	0.005	0.009	0.005	0.000	0.005	0.011	0.006
Neuroticism × Grip	0.004	0.002	−0.006**	0.002	0.004*	0.002	−0.001	0.001
Neuroticism × Grip × Slope	0.001*	0.000	—	—	—	—	0.001*	0.000
Extraversion × Speed	—	—	—	—	−0.005*	0.002	—	—
Extraversion × Morbidity	—	—	−0.047*	0.021	—	—	—	—
Extraversion × Grip	—	—	−0.003	0.002	—	—	—	—
Extraversion × Grip × Slope	—	—	−0.001*	0.001	—	—	—	—
Extraversion × Speed × Slope	—	—	—	—	−0.001*	0.001	—	—
Variance intercept	0.364	0.055	0.399	0.051	0.416	0.052	0.562	0.067
Variance slope	0.005	0.001	0.005	0.001	0.004	0.001	0.009	0.001
Variance slope^2	—	—	—	—	—	—	—	—
Cov. intercept, slope	0.022	0.008	0.025	0.007	0.022	0.006	0.049	0.009
Cov. intercept, slope^2	—	—	—	—	—	—	—	—
Cov. slope, slope^2	—	—	—	—	—	—	—	—
Residual variance	0.613	0.015	0.505	0.012	0.423	0.010	0.587	0.014

Note. N = 3,472. Grip = grip strength, speed = perceptual speed; SOEP = German Socio-Economic Panel.
* $p < .05$. ** $p < .001$.

Moving beyond these average trajectories, our results corroborate and extend previous research by showing that performance-based indicators of physical and cognitive health were intertwined with facets of subjective well-being in old age (Diener & Chan, 2011; Steptoe et al., 2012). Importantly, these results overcome issues of shared method variance, confirm that health–well-being associations arise when actual opposed to perceived health is measured, and reinforce the importance of physical and cognitive health for individual difference in levels of subjective well-being in old age.

Three sets of factors may have contributed to why none of our health indicators were associated with change in subjective well-being. As a first set, we argue that the potential consequences of physical and cognitive health may depend upon the specific facet of health considered. Following extant theories (e.g., Watson & Pennebaker, 1989), we would assume that functional limitations may be particularly relevant because these indicate disruptions of daily routines and lack of people's usual means to reach their goals. Second, change in subjective well-being may only be observable when the severity of health issues reaches a certain threshold. To illustrate, because the BASE-II and SOEP sample contained predominantly healthy young-old adults, these individuals may not have encountered the severity of health problems that threaten people's well-being. As a third set, changes in well-being may be prompted by other, even more salient factors such as increasingly diminished interpersonal resources and adverse life events. To illustrate, experiencing the loss of one's partner or close friends are thought to undermine older adults' sense of identity, stability, purpose, belonging, security, and self-worth, all of which are central to the maintenance of positive subjective well-being (Cohen, 2004).

The Role of Personality

These results address recent discussions that the predictive effects of personality for subjective well-being in old age become weaker when physical and cognitive health decrements become increasingly more important in shaping self and emotional regulation as people age (Dolan et al., 2008; Magee et al., 2013). Therefore, the fact that both extraversion and neuroticism continued to be intertwined with subjective well-being, over and above the statistically significant health–well-being

associations, illustrates the important and persistent role of personality for well-being outcomes throughout old age. Interestingly, our results showed that in all cases, high extraversion and low neuroticism predicted positive outcomes in all evaluative well-being facets—a finding consistent with previous research (Steel et al., 2008; Suh et al., 1996)—but only neuroticism was consistently associated with all discrete emotions. These findings are in line with neuroticism being defined as hypersensitivity to minor frustrations of daily life, which are thought to trigger negative emotions and make experiencing positive affect less probable (Vittersø, 2001; Watson & Clark, 1984). In contrast, extraversion is only expected to show associations with positive affect through an increased propensity for experiencing positive emotions. That extraversion and neuroticism were not associated with individual differences in change trajectories for life satisfaction is consistent with reports focusing on terminal decline in well-being (Mueller et al., 2019).

Taken together, these results emphasize both that challenges posed by physical and cognitive health for subjective well-being represent crucial concerns for policymakers and the need to integrate traditional interventions targeted at promoting positive subjective well-being through physical and/or cognitive health training with programs tailored toward personality profiles. For example, interventions that promote daily life strategies aimed at reducing restriction with the external world (a pathway through which health is theorized to undermine well-being; Watson & Pennebaker, 1989), such as implementing social programs targeted at "those who live alone or in rural populations or who suffer from a chronic or relapsing . . . physical illness" (WHO, 2017), may be less accessible and effective among those whose well-being is less shaped by their social world (i.e. low extraversion; McCrae & Costa, 1991).

Health by Personality Interactions

Above and beyond their unique associations with well-being in old age, we found some evidence to suggest that extraversion and neuroticism interacted with specific health indicators to affect older adults' emotional experiences but were unrelated to life satisfaction and morale. Our limited findings suggested that extraversion and neuroticism operate both as buffers and as risk factors for emotional experiences in old age—a finding consistent with the idea that the adaptive potential of these traits change across old age, such that the beneficial (extraversion) or disadvantageous (neuroticism) effects of these traits reverse in the face of increasing losses (Hutteman, Hennecke, Orth, Reitz, & Specht, 2014; Staudinger & Fleeson, 1996).

Although these results provide some evidence that the consequences of physical and cognitive health challenges for emotions (though not evaluative well-being) in old age are more pronounced among people with certain dispositions, these effects emerged only in certain contexts and were small in size and should thus be interpreted with caution.

Study Limitations and Outlook

The present study was in the position to examine the unique and interactive predictive effects of health and personality for trajectories of subjective well-being in a large-scale community-dwelling sample of older Berlin residents (BASE-II) and in a nationally representative sample of older adults (SOEP), who—in both samples—provided the comparable performance-based indicators of physical and cognitive health. We also note several limitations of our measures, study design, and samples. Beginning with limitations of our measures, our personality measurement was based on relatively global trait-level information on the Big Five factors. Previous research has reported initial evidence for the utility of examining more differentiated facet-level associations of personality and well-being (DeNeve & Cooper, 1998), which was not possible for this study. As stated, McCrae and Costa (1991) distinguished between temperamental and instrumental pathways from which personality affects well-being. The temperamental pathway is most closely related to emotionality aspects of personality (e.g., the positive emotion facet of extraversion: Sutin, Zonderman, Ferrucci, & Terracciano, 2013), while the instrumental pathway relates more closely to behavior-driven aspects of personality (e.g., the sociability facet of extraversion). Using facet-level data could therefore help to foster our understanding of the specific mechanisms that drive personality–well-being associations and personality–health interaction effects. In addition, shared method variance for our indicators of personality and well-being (self-report) might inflate personality–well-being associations (Schimmack, Böckenholt, & Reisenzein, 2002). Of note is also that we focused on three specific indicators of health, which are not representative of the much broader physical and cognitive health constructs. For example, our perceptual speed measure might be less (subjectively) salient to an individual than decline in other cognitive abilities such as episodic memory (Lövdén, Ghisletta, & Lindenberger, 2005). It is reasonable to expect that declines in more salient aspects of cognition limit one's functional capacity more immediately and in turn impact well-being more directly. Lastly, the measurement of morbidity was not parallel between the BASE-II and SOEP studies, which limits the direct comparability of findings. In particular, in BASE-II we counted the number of diseases weighted by severity, whereas in the SOEP we only counted the number of diseases.

As limitations of our study design, our measurements were spaced several years apart, limiting us to snapshots of development, making it unclear whether our results generalize to daily life dynamics. It might be highly informative to study health, personality, and well-being dynamics across multiple time-scales and contexts. One avenue for future research would be to explore how daily health covaries with daily well-being and whether these associations tie into long-term well-being development across old age (Charles & Almeida, 2006). Associations between health and well-being are often weaker for state positive affect and health (Cohen & Pressman, 2006), suggesting that separating trait from state may reveal different and complementary perspectives.

An important limitation is that health and personality were only collected at one time point. It was thus not possible to examine how changes in these domains predict changes in well-being and affect. To illustrate, we expect that in very old age, severe and broad-based health limitations drag down well-being. Drawing from arguments that the functional implications of neuroticism may change late in life, it is probably not low levels of neuroticism that operate as a buffer, but moderately high levels (see Mueller et al., 2017, 2018, 2019). It will be intriguing to examine such questions in future, more mechanism-oriented studies.

Finally, we acknowledge that the generalizability of our sample is limited. First, our samples included very few participants in the oldest age range making it unknown whether our findings generalize to the fourth age (for overview, see Gerstorf & Ram, 2013). On a related note, the sample contained predominantly healthy older adults who may therefore not have encountered the severity of health issues that threaten their well-being. Second, although we made use of two large-scale data sets that allowed us access to rich—and comparable—data from community-dwelling and nationally representative samples, all participants were exclusively recruited from Germany, meaning that our findings might not generalize to people from other parts of the Western world (or beyond). Because of this, we strongly encourage future research to corroborate our findings in more heterogeneous samples.

Conclusions

Taken together, results from our study corroborate and extend previous research by showing that suffering from morbidity and poor performances on grip strength and perceptual speed were independently associated with reporting lower life satisfaction, psychological morale, and happiness as well as feeling more anger, fear, and sadness at age 70. Over and above these associations, our results also showed that extraversion and neuroticism continue to be unique and consistent predictors of all facets of subjective well-being. In contrast, evidence for differential change associations were rare and facet-specific. Some evidence emerged for the proposal that personality and aspects of health interact to predict level and change trajectories of well-being and emotion across old age, but these were not consistent across studies and were very small in size.

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