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Personality and Subjective Age: Evidence From Six Samples

Yannick Stephan[1], Angelina R. Sutin[2], Anna Kornadt[3], Brice Canada[4], and Antonio Terracciano[5]

[1] EuroMov, University of Montpellier
[2] Department of Behavioral Sciences and Social Medicine, College of Medicine, Florida State University
[3] Department of Behavioral and Cognitive Sciences, University of Luxembourg
[4] L-VIS, University of Lyon 1
[5] Department of Geriatrics, College of Medicine, Florida State University

Subjective age is associated with health-related outcomes across adulthood. The present study examined the cross-sectional and longitudinal associations between personality traits and subjective age. Participants ($N > 31,000$) were from the Midlife in the United States Study (MIDUS), the Health and Retirement Study (HRS), the National Health and Aging Study (NHATS), the Wisconsin Longitudinal Study Graduate (WLSG) and Siblings (WLSS) samples, and the English Longitudinal Study of Aging (ELSA). Demographic factors, personality traits, and subjective age were assessed at baseline. Subjective age was assessed again in the MIDUS, the HRS, and the NHATS, 4 to almost 20 years later. Across the samples and a meta-analysis, higher neuroticism was related to an older subjective age, whereas higher extraversion, openness, agreeableness, and conscientiousness were associated with a younger subjective age. Self-rated health, physical activity, chronic conditions, and depressive symptoms partially mediated these relationships. There was little evidence that chronological age moderated these associations. Multilevel longitudinal analyses found similar associations with the intercept and weak evidence for an association with the slope in the opposite of the expected direction: Lower neuroticism and higher extraversion, agreeableness, and conscientiousness were related to feeling relatively older over time. The present study provides replicable evidence that personality is related to subjective age. It extends existing conceptualization of subjective age as a biopsychosocial marker of aging by showing that how old or young individuals feel partly reflects personality traits.

Keywords: subjective age, personality traits, adulthood

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Subjective age (i.e., the age people feel relative to their chronological age) has received substantial attention in gerontological research in the last decade (Wurm et al., 2017). A large majority of middle-aged and older adults feel younger than their chronological age across the globe (Pinquart & Wahl, 2021). A younger subjective age is associated with a range of positive outcomes across adulthood (Alonso Debreczeni & Bailey, 2021; Westerhof et al., 2014). For example, feeling younger is associated with lower risk of incident dementia (Stephan, Sutin, Luchetti, & Terracciano, 2018), and a lower risk of mortality, even after controlling for chronological age and clinical and behavioral risk factors (Rippon & Steptoe, 2015; Stephan, Sutin, & Terracciano, 2018). At the other

This article was published Online First March 17, 2022.
Anna Kornadt https://orcid.org/0000-0002-6634-0812
Brice Canada https://orcid.org/0000-0002-2098-433X
Antonio Terracciano https://orcid.org/0000-0001-5799-8885
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Correspondence concerning this article should be addressed to Yannick Stephan, EuroMov, University of Montpellier, UFRSTAPS, 700, Avenue du Pic Saint Loup, Montpellier 34090, France. Email: yannick.stephan@umontpellier.fr

end of the spectrum, an older subjective age can help identify individuals who are at risk for poor health, cognitive decline, and impairment. Given its importance in predicting crucial age-related outcomes, the present study focused on psychological factors that are related to subjective age over time.

According to existing conceptualizations, subjective age is a biopsychosocial marker of aging that is sensitive to a range of cues about aging (Kotter-Grühn et al., 2015b; Stephan et al., 2015a; Thyagarajan et al., 2019; Weiss & Weiss, 2019). From this perspective, subjective age predicts significant age-related outcomes such as mortality or incident dementia because it reflects biological and health-related factors, social processes, and psychological dispositions relevant to these outcomes. Indeed, a younger subjective age reflects better health in terms of biomarkers associated with aging processes (Thyagarajan et al., 2019), better functional health (Barrett & Gumber, 2020; Hughes & Lachman, 2018), positive perceptions of health and fewer depressive symptoms (Stephan et al., 2015a). Among this set of predictors, better self-rated health is the strongest predictor of feeling younger than one's age (Stephan et al., 2015a). In addition, prospective studies have found that health behaviors, such as physical activity, are associated with feeling younger than one's age (Stephan, Sutin, & Terracciano, 2020). Subjective age is also sensitive to environmental cues about aging. For example, changes in subjective age result from exposure to age discrimination and negative aging stereotypes (Deshayes et al., 2020; Kornadt et al., 2018; Stephan et al., 2015a), social comparison processes (Hughes & Lachman, 2018) as well as other psychosocial stressors (Palgi et al., 2019; Terracciano et al., 2021, Wettstein et al., 2021). Less research, however, has addressed the role of stable psychological dispositions in how old an individual feels. The present study thus focuses on the association between personality and subjective age.

According to the five-factor model (FFM; McCrae & John, 1992), most personality traits are summarized by five broad traits: neuroticism (the tendency to experience distress and other negative emotions), extraversion (the tendency to be sociable, assertive, and optimistic), openness (the tendency to be curious and unconventional), agreeableness (the tendency to be trusting and cooperative), and conscientiousness (the tendency to be disciplined, dutiful, and organized). There are several reasons to expect a relationship between personality and subjective age. From a theoretical perspective, health-related factors and social comparison processes may be significant mechanisms that explain the association between personality and subjective age. Specifically, theoretical models suggest that FFM traits play a crucial role in individuals' health in adulthood (Friedman & Kern, 2014). Given that health-related factors shape subjective age, personality is likely related to how old or young individuals experience themselves to be. For example, higher extraversion, openness, and conscientiousness are predictive of better health-related outcomes, such as better physical functioning (Canada et al., 2021), higher self-rated health (Stephan, Sutin, Luchetti, et al., 2020), and fewer depressive symptoms (Hakulinen et al., 2015) that in turn may lead to a younger subjective age (Barrett & Gumber, 2020; Spuling et al., 2013; Stephan et al., 2015a). The better physical and mental health of extraverted, open, and conscientious individuals may lead them to experience less pain, fatigue, stress, and more positive affect in daily activities, resulting in a younger subjective age. In contrast, neuroticism may increase the risk of feeling older partly because it is related to more negative health outcomes (Canada et al., 2021; Hakulinen et al., 2015; Stephan, Sutin, Luchetti, et al., 2020). Individuals who score high on neuroticism also experience more negative sensations and feelings in their daily activities, leading to feeling older than one's age. Other theoretical models postulate that personality predicts health-related behaviors (Turiano et al., 2015) that are known to contribute to subjective age. For example, lower neuroticism, higher extraversion, openness, and conscientiousness motivate more frequent physical activity (Sutin et al., 2016), which has been prospectively related to feeling younger (Stephan, Sutin, & Terracciano, 2020). This physically active lifestyle is related to a younger subjective age through its health benefits (Stephan, Sutin, & Terracciano, 2020).

In addition to health and behavioral pathways, the association between personality traits and subjective age could be due to social comparison processes. Age differences in personality traits are widely recognized by laypeople (e.g., older adults are perceived as less open, less extroverted, and less impulsive than younger adults), similar across cultures, consistent in direction, but exaggerated in magnitude compared with actual age differences in personality (Chan et al., 2012). It is possible that older adults with a personality profile more consistent with the profile of younger individuals (e.g., higher openness or extraversion) may report a younger subjective age. Indeed, middle-aged and older individuals may compare their personality with those of their age peers and feel closer to the profile of younger individuals, resulting in a younger subjective age.

The associations between personality traits and subjective age have been consistent with these assumptions. Middle-aged and older adults higher in extraversion and openness, for example, tend to feel younger than their age (Canada et al., 2013; Hubley & Hultsch, 1996; Stephan et al., 2012; Weiss et al., 2019). The associations between conscientiousness and neuroticism and subjective age, however, are less consistent. For example, conscientiousness was related to a younger subjective age in a sample of individuals undergoing cataract surgery (Knoll et al., 2004), whereas no association was observed in other studies with middle-aged and older adults (Canada et al., 2013; Hubley & Hultsch, 1996, Stephan et al., 2012) and even an association with an older subjective age among young adults (Stephan et al., 2012). Higher neuroticism has been associated with an older subjective age in one study (Stephan, Sutin, Kornadt, et al., 2018), whereas no association was observed in other studies (Canada et al., 2013; Hubley & Hultsch, 1996; Stephan et al., 2012). Agreeableness is generally unrelated to subjective age (Canada et al., 2013; Stephan et al., 2012).

In the present study, we build on this evidence base in several ways to extend our knowledge of the relationship between personality and subjective age. First, there has not yet been a large-scale, multistudy investigation of this relationship. Studies with multiple samples are useful to assess replicability and robustness of associations and provide a metaanalytic synthesis of the evidence. To date, studies have focused on either personality traits as mediators of the association between different predictors and subjective age (Stephan, Sutin, & Terracciano, 2020) or correlated change between subjective age and personality (Stephan et al., 2015b) in single studies. Second, many previous studies have not tested the full FFM but only focused on one or a few traits. Third, most studies have been cross-sectional; less is known about the longitudinal associations between personality and changes in subjective age over time. Fourth, assessing potential

mediators for these associations can help deepen our understanding of the processes underlying the observed associations.

The present research used six samples to examine the association between personality and subjective age, both cross-sectionally and longitudinally. Based on our theoretical framework and past research, it was hypothesized that high neuroticism would be related to an older subjective age both concurrently and over time, whereas higher extraversion, openness, and conscientiousness would be related to a younger subjective age concurrently and over time. No association between agreeableness and subjective age was expected. Additional analyses tested whether the association between personality and subjective age was mediated by self-rated health, physical activity, depressive symptoms, and chronic conditions. The extent to which age moderated the relationship between personality and subjective age was also examined.

Method

Transparency and Openness

Participants were drawn from six large samples of adults: The Wisconsin Longitudinal Study Graduate (WLSG) and Siblings (WLSS) samples, the National Health and Aging Trends Study (NHATS), the Midlife in the United States Survey (MIDUS), the Health and Retirement Study (HRS), and the English Longitudinal Study of Aging (ELSA). Institutional Review Board review was not needed for this study because it was based on de-identified, publicly available datasets. The sample sizes were determined by the availability of the variables of interest. Specifically, in each sample, participants were included if they had complete data on the five personality traits, subjective age, and demographic factors (age, sex, education, and race in NHATS, MIDUS, HRS, and ELSA; age, sex, and education in WLS samples). The samples size provided sufficient power to detect even small effect sizes. The relationship between personality and change in subjective age was tested in the NHATS, the MIDUS, and the HRS because follow-up data on subjective age were available in these samples. The potential mediators were assessed at the same wave as personality and subjective age (baseline). For the HRS, the data are available in a replication package at the download site (https://hrsdata.isr.umich.edu/data-products). The conditions of use for the MIDUS, NHATS, ELSA, and WLS do not allow for the redistribution of the data from these studies used for the present analyses. Data from these studies, however, are available for download after registration with the study. Analytic codes are in supplementary material. Descriptive statistics for the six samples are in Table 1. A summary of the characteristics of the datasets used in the present study is presented in Supplemental Table S1.

Participants

The WLS is a longitudinal study of men and women who graduated from Wisconsin high schools in 1957 (WLSG) and their selected Siblings (WLSS). The WLS sample is broadly representative of white, non-Hispanic American men and women who have completed at least a high school education. Data on personality, subjective age, and demographic factors were obtained from the 2011 wave for both the WLSG and the WLSS. Complete data were obtained from 4,355 individuals in the WLSG (54% women, $M_{age} = 71.20$, $SD = 0.92$) and from 2,341 participants in the WLSS (53% women, $M_{age} = 69.15$, $SD = 6.62$).

The NHATS is a nationally representative longitudinal study of Medicare enrollees aged 65 years and older who started in 2011. Personality was first assessed in 2013 for one-third of the sample, and in 2014 for a second third. The two waves were combined, resulting in a total of 2,395 individuals who provided complete data on personality, subjective age, and demographic factors (58% women, $M_{age} = 78.87$, $SD = 7.20$). Follow-up subjective age data were obtained in 2014, 2015, 2016, and 2017 for participants from the 2013 wave and in 2015, 2016, 2017, and, 2018 for participants in the 2014 wave. Among these participants, 2054 individuals had at least one measure of subjective age at follow-up.

The MIDUS is a longitudinal study of noninstitutionalized, English-speaking US adults. Complete data on personality, subjective age, and demographic factors were obtained from a total of 5,909 participants (52% women, $M_{age} = 46.83$, $SD = 12.83$) in the first wave (1995–1996, MIDUS I). Follow-up subjective age data were obtained in 2004–2006 (MIDUS II) and 2013–2014 (MIDUS III). From the baseline sample, 3,787 participants had at least one assessment of subjective age at follow-up.

The HRS is a national longitudinal study of Americans older than 50 years and their spouses. Personality, subjective age, and demographic factors were assessed in 2008 for half of the sample and in 2010 for the

Table 1
Baseline Characteristics of the Samples

	MIDUS		HRS		NHATS		WLSG		WLSS		ELSA	
Variable	*M*/%	*SD*	*M*/%	*SD*	*M*/%	*SD*	*M*/%	*SD*	*M*/%	*SD*	*M*/%	*SD*
Age (years)	46.83	12.83	69.60	9.59	78.87	7.20	71.20	0.92	69.15	6.62	65.14	7.82
Sex (% women)	52%	—	58%	—	58%	—	54%	—	53%	—	56%	—
Race (% White)	89%	—	85%	—	74%	—	100%	—	100%	—	98%	—
Education	6.90	2.47	12.93	2.92	5.31	2.24	13.88	2.40	14.14	2.57	4.37	2.19
Neuroticism	2.23	0.66	2.00	0.61	2.21	0.84	3.03	0.93	3.02	0.92	2.09	0.58
Extraversion	3.20	0.56	3.19	0.56	3.17	0.73	3.79	0.88	3.77	0.88	3.17	0.54
Openness	3.02	0.52	2.93	0.56	2.86	0.81	3.46	0.76	3.47	0.75	2.91	0.54
Agreeableness	3.49	0.49	3.53	0.48	3.59	0.52	4.80	0.71	4.79	0.71	3.52	0.47
Conscientiousness	3.43	0.44	3.38	0.48	3.26	0.59	4.75	0.71	4.74	0.70	3.33	0.47
Subjective age	−0.15	0.16	−0.15	0.16	−0.15	0.16	−0.17	0.13	−0.17	0.13	−0.15	0.16

Note. Midlife in the United States Study (MIDUS): $N = 5,909$; Health and Retirement Study (HRS): $N = 11,034$; National Health and Aging Trends Study (NHATS): $N = 2,395$; Wisconsin Longitudinal Study Graduate (WLSG): $N = 4,355$; Siblings (WLSS): $N = 2,341$; English Longitudinal Study of Aging (ELSA) = 5,765. See Method section for differences in measures across the six samples.

other half. Data from both waves were combined, resulting in a total of 11,034 participants with complete data (58% women, M_{age} = 69.60, SD = 9.59). Subjective age measures were available in the 2012 and 2016 waves for the 2008 sample and in the 2014 and 2018 waves for the 2010 sample. Of the baseline sample, 8,141 participants had at least one measure of subjective age at follow-up.

ELSA is a panel study of a representative cohort of men and women living in England aged 50 years or over. Personality traits were assessed for the first time at Wave 5 (2010). However, this wave did not include the subjective age measure. Subjective age data were obtained from Wave 7 (2014). A total of 5,765 individuals provided complete data (56% women, M_{age} = 65.14, SD = 7.82).

Measures

Subjective Age

In the six samples, participants were asked to report the age they felt in years. There were slight differences between samples in the time frame used. In the HRS and ELSA, participants were simply asked to report the age they feel, whereas in the MIDUS and WLS samples, they were asked to indicate how old they feel most of the time. In the NHATS, participants were asked to report the age felt most of the time in the last month. A proportional discrepancy score was computed by subtracting chronological age from felt age, and then dividing by chronological age. Positive values indicated an older subjective age, whereas negative values indicated a younger subjective age. Individuals with discrepancy scores three standard deviations above the mean were considered outliers and excluded from the analysis (n = 71 in the WLSG, n = 31 in the WLSS, n = 47 in ELSA, n = 40 in NHATS, n = 82 in MIDUS, and n = 107 in HRS). A summary of the subjective age items used in the present study is in Supplemental Table S1.

Personality

Personality was assessed using the Midlife Development Inventory (MIDI; Zimprich et al., 2012) in the MIDUS, the HRS, ELSA, and NHATS. A 26-item version was used in the HRS and the ELSA, a 25-item version was used in the MIDUS, and a 10-item version was used in NHATS. In each sample, participants indicated how much each adjective described them on a scale ranging from 1 (*not at all*) to 4 (*a lot*). Example items were worrying (neuroticism), outgoing (extraversion), curious (openness), warm (agreeableness), and organized (conscientiousness). The WLSG and WLSS assessed personality using a 29-item version of the Big Five Inventory (BFI; John et al., 1991). Participants rated their agreement or disagreement with descriptive statements such as: "To what extent do you agree that you see yourself as someone who worries a lot?" (neuroticism), "To what extent do you agree that you see yourself as someone who is talkative?" (extraversion), "To what extent do you agree that you see yourself as someone who has an active imagination?" (openness), "To what extent do you agree that you see yourself as someone who is generally trusting?" (agreeableness), and "To what extent do you agree that you see yourself as someone who does things efficiently?" (conscientiousness). A 6-point scale ranging from 1 (*disagree strongly*) to 6 (*agree strongly*) was used. A summary of the personality scales used in the present study is in Supplemental Table S1.

Mediators

Self-rated health, physical activity, depressive symptoms, and chronic conditions (assessed at the same time as personality) were considered as mediators. A single-item self-rated health measure was used in each sample (e.g., "Would you say your health is excellent, very good, good, fair, or poor?"). In the HRS, ELSA, and NHATS, a scale from 1 (*poor*) to 5 (*excellent*) was used. The WLS used a scale from 1 (*very poor*) to 5 (*excellent*). The MIDUS asked how participants would rate their health these days on a scale ranging from 0 (*the worst possible health)* to 10 (*the best possible health*). Physical activity was measured in the HRS and ELSA with two items that asked how often participants take part in vigorous and moderate sports or activities on a scale from 1 (*hardly ever or never*) to 4 (*more than once a week*). Answers to the two items were averaged. Physical activity in both WLS samples was assessed with four items on the hours per month spent doing vigorous or light physical activities, both alone and with others during the last year. The answers to these items were summed. Participants in the MIDUS reported how often they engaged in vigorous and moderate leisure physical activity during their leisure or free time both in the summer and the winter using a scale from 1 (*never*) to 6 (*several times a week*). Summer and winter ratings were averaged. In the NHATS, participants were asked to report whether they ever go walking for exercise (yes/no) and ever spent time on vigorous activities in the last month (yes/no). Responses to the two items were summed.

Depressive symptoms were assessed using the 8-item version of the Centers for Epidemiologic Study Depression (CES-D; Wallace et al., 2000) in the HRS and ELSA; the full 20-item version (Radloff, 1977) was used in both WLS samples. In HRS and ELSA, participants indicated whether they experienced eight symptoms during the past week using a yes/no format. In the WLS, participants indicated the number of days during the past week they experienced each symptom. In the four samples, answers were summed across items, with higher scores representing higher depressive symptoms. Depressive symptoms were measured with the Composite International Diagnostic Interview Short Form scales (CIDI-SF; Kessler et al., 1998) in the MIDUS. The sum of participants' experience of depressed mood and anhedonia that lasted for 2 weeks of the last 12 months was computed. Depressive symptoms were measured with the Patient Health Questionnaire-2 (PHQ-2; Kroenke et al., 2003) in the NHATS. Participants indicated how often they had little interest or pleasure in doing things and how often they felt down and depressed or hopeless during the last month on a scale from 1 (*not at all*) to 4 (*nearly every day*). The two items were averaged. Finally, in the six samples, the sum of diagnosed conditions was used as a measure of chronic conditions. Participants reported whether a medical professional ever told them that they had diabetes, high blood pressure, heart condition, and other illnesses. Chronic conditions were obtained by summing the number of diagnosed conditions in each sample.

Covariates

In the six samples, age, sex, and education were included as covariates. Race was also controlled in the MIDUS, NHATS, HRS, and ELSA (WLS participants were all white). The demographic

factors were included because they have been found to contribute to subjective age in past research (Stephan et al., 2015a).

Data Analysis

Linear regression was used to test the relationship between personality and the continuous measure of subjective age. In these analyses, the proportional discrepancy score was regressed on each trait, controlling for demographic factors. The estimates from each sample were pooled with random-effects meta-analyses using the Comprehensive Meta-Analysis software.

The PROCESS macro using 5,000 bootstrapped samples and 95% confidence intervals (Hayes, 2018) was used to test whether self-rated health, physical activity, depressive symptoms, and chronic conditions mediated the association between personality and subjective age. The four mediators were included simultaneously in the analysis. We also tested whether the association between personality and subjective age was moderated by age by including an interaction term for each of the five factors and chronological age. Personality traits were standardized in all analyses.

In HRS, MIDUS, and NHATS, multilevel modeling (MLM) analysis was used to test the association between personality and change in subjective age, using a linear mixed model with restricted maximum likelihood estimation method. Separate models were tested for each personality trait, and all analyses included demographic covariates. Personality traits were standardized. Personality traits and demographic covariates were entered as predictors of the intercept and slope. The interaction of the trait with time was computed to examine the predictive role of personality traits for the slope of subjective age. Random effects for the intercept and slopes were also included in the model. A random-effect meta-analysis was computed by pooling the estimates from each sample.

Results

Descriptive statistics are in Table 1. As expected, the meta-analysis indicated that neuroticism was positively related to the proportional discrepancy score (i.e., older subjective age), whereas extraversion, openness, and conscientiousness were inversely related to the proportional discrepancy score (Table 2). Unexpectedly, agreeableness was also negatively related to the proportional discrepancy score (Table 2). These associations were observed consistently across the six samples. These results suggest that higher neuroticism is related to an older subjective age, whereas higher extraversion, agreeableness, openness, and conscientiousness are associated with a younger subjective age. The overall pattern of association remained the same without the covariates (Supplemental Table S2).

The mediation analysis indicated that depressive symptoms, physical activity, chronic conditions, and self-rated health partially mediated the relationship between personality and subjective age (Table 3). The associations between personality and the mediators and between the mediators and subjective age are in Table S4 and Table S5, respectively. For neuroticism, there was replicable evidence of mediation through lower self-rated health, higher depressive symptoms, higher chronic conditions, and (to a lesser extent) lower physical activity. Higher extraversion and higher conscientiousness were associated with a younger subjective age through

Table 2
Summary of Regression Analysis Predicting Subjective Age From Personality Traits

Variable	MIDUS[a]	HRS[a]	NHATS[a]	WLSG[b]	WLSS[b]	ELSA[a]	Random effect	Heterogeneity Tau
Neuroticism	.15 (.13; .18) $p < .001$	.21 (.19; .23) $p < .001$	.11 (.07; .16) $p < .001$	.15 (.12; .18) $p < .001$	.17 (.13; .21) $p < .001$	.16 (.13; .18) $p < .001$	0.16 (0.13; 0.19) $p < .001$	0.03
Extraversion	−.18 (−.20; −.15) $p < .001$	−.25 (−.27; −.24) $p < .001$	−.16 (−.20; −.12) $p < .001$	−.14 (−.16; −.11) $p < .001$	−.17 (−.21; −.13) $p < .001$	−.22 (−.25; −.20) $p < .001$	−0.19 (−0.23; −0.15) $p < .001$	0.05
Openness	−.16 (−.19; −.14) $p < .001$	−.24 (−.26; −.22) $p < .001$	−.15 (−.19; −.11) $p < .001$	−.19 (−.22; −.16) $p < .001$	−.17 (−.22; −.13) $p < .001$	−.19 (−.21; −.16) $p < .001$	−0.18 (−0.22; −0.15) $p < .001$	0.04
Agreeableness	−.11 (−.13; −.08) $p < .001$	−.15 (−.17; −.13) $p < .001$	−.11 (−.15; −.07) $p < .001$	−.11 (−.14; −.08) $p < .001$	−.07 (−.11; −.02) $p = .002$	−.11 (−.13; −.08) $p < .001$	−0.11 (−0.13; −0.09) $p < .001$	0.02
Conscientiousness	−.10 (−.13; −.08) $p < .001$	−.18 (−.20; −.16) $p < .001$	−.08 (−.12; −.04) $p < .001$	−.14 (−.17; −.11) $p < .001$	−.14 (−.18; −.10) $p < .001$	−.11 (−.13; −.08) $p < .001$	−0.13 (−0.16; −0.09) $p < .001$	0.04

Note. Midlife in the United States Study (MIDUS): $N = 5,909$; Health and Retirement Study (HRS): $N = 11,034$; National Health and Aging Trends Study (NHATS): $N = 2,395$; Wisconsin Longitudinal Study Graduate (WLSG): $N = 4,355$; Siblings (WLSS): $N = 2,341$; English Longitudinal Study of Aging (ELSA) = 5,765. Coefficients are standardized regression coefficients.
[a] Adjusted for age, sex, education, and race. [b] Adjusted for age, sex, and education.

Table 3
Summary of Bootstrap Analysis

Variable	Bootstrap analysis[a]				
	Neuroticism	Extraversion	Openness	Agreeableness	Conscientiousness
MIDUS					
Depressive symptoms	.0003 (−.0008; .015)	−.0002 (−.0007; .0002)	.000 (−.0001; .0002)	.000 (−.0001; .0002)	−.0002 (−.0006; .0001)
Physical activity	.0009 (.0004; .0014)	−.0013 (−.0021; −.0005)	−.0010 (−.0017; −.0004)	−.0005 (−.0009; −.0002)	−.0011 (−.0017; −.0006)
Chronic conditions	.0025 (.0011; .0040)	−.0013 (−.0020; −.0007)	−.0003 (−.0007; .0000)	−.0002 (−.0005; .0002)	−.0016 (−.0024; −.0009)
Self-rated health	.0078 (.0063; .0094)	−.0071 (−.0085; −.0057)	−.0042 (−.0053; −.0032)	−.0041 (−.0053; −.0031)	−.008 (−.0096; −.0064)
Direct effect[b]	.08 (.01)	−.12 (.01)	−.13 (.01)	−.08 (.01)	−.03 (.01)
	$p < .001$	$p < .001$	$p < .001$	$p < .001$	$p = .008$
HRS					
Depressive symptoms	.004 (.0022; .0052)	−.0024 (−.0032; −.0017)	−.0016 (−.0022; −.0011)	−.0014 (−.0018; −.0009)	−.0027 (−.0036; −.0019)
Physical activity	.0009 (.0006; .0013)	−.0011 (−.0017; −.0006)	−.0010 (−.0014; −.0005)	−.0006 (−.0009; −.0003)	−.0012 (−.0017; −.0008)
Chronic conditions	.0007 (.0003; .0011)	−.0005 (−.0008; −.0002)	−.0002 (−.0004; −.0001)	.0001 (−.0001; .0002)	−.0006 (−.0010; −.0002)
Self-rated health	.0084 (.0072; .0095)	−.0069 (−.0079; −.0059)	−.0047 (−.0056; −.0039)	−.0032 (−.0040; −.0024)	−.0072 (−.0083; −.0062)
Direct effect[b]	.11 (.01)	−.18 (.01)	−.18 (.01)	−.11 (.01)	−.10 (.01)
	$p < .001$	$p < .001$	$p < .001$	$p < .001$	$p < .001$
ELSA					
Depressive symptoms	.0028 (.0011; .0045)	−.0021 (−.0034; −.0009)	−.0016 (−.0024; −.0009)	−.0008 (−.0013; −.0004)	−.0024 (−.0034; −.0014)
Physical activity	.0003 (.000; .0007)	−.0003 (−.0012; .0006)	−.0003 (−.0008; .0001)	.000 (−.0002; .0001)	−.0005 (−.0011; .001)
Chronic conditions	.0007 (.0001; .0013)	−.0007 (−.0014; −.0001)	−.0004 (−.0008; −.0001)	.000 (−.0002; .0001)	−.0008 (−.0015; −.0002)
Self-rated health	.0050 (.0038; .0063)	−.0055 (−.0069; −.0040)	−.0034 (−.0044; −.0025)	−.0013 (−.0020; −.0006)	−.0053 (−.0066; −.0041)
Direct effect[b]	.10 (.01)	−.17 (.01)	−.15 (.01)	−.09 (.01)	−.05 (.01)
	$p < .001$	$p < .001$	$p < .001$	$p < .001$	$p < .001$
NHATS					
Depressive symptoms	.0049 (.0025; .0073)	−.0022 (−.0036; −.0011)	−.0008 (−.0017; .000)	−.0019 (−.0032; −.0009)	−.0025 (−.0039; −.0013)
Physical activity	.000 (−.0005; .0006)	−.0007 (−.0014; −.0002)	−.0009 (−.0017; −.0003)	−.0006 (−.0012; −.0001)	−.0006 (−.0013; −.0001)
Chronic conditions	−.0001 (−.0006; .0002)	.0002 (−.0001; .0006)	.000 (−.0003; .0004)	−.0001 (−.0005; .0002)	.0000 (−.0003; .0003)
Self-rated health	.0045 (.0030; .0062)	−.0028 (−.0042; −.0017)	−.0020 (−.0033; −.0008)	−.0017 (−.0030; −.0006)	−.0033 (−.0048; −.0019)
Direct effect[b]	.06 (.02)	−.12 (.02)	−.13 (.02)	−.08 (.02)	−.04 (.02)
	$p = .009$	$p < .001$	$p < .001$	$p < .001$	$p = .06$
WLSG					
Depressive symptoms	.0060 (.0040; .0080)	−.0029 (−.0038; −.0020)	−.0019 (−.0028; −.0012)	−.0039 (−.0051; −.0027)	−.0043 (−.0056; −.0031)
Physical activity	.000 (−.0002; .0000)	.0001 (−.0001; .0003)	.0001 (.0000; .0002)	.0001 (.0000; .0003)	.0002 (−.0001; .0004)
Chronic conditions	.0007 (.0001; .0013)	−.0003 (−.0006; .0000)	.0004 (.0001; .0007)	−.0002 (−.0005; .0000)	−.0006 (−.0011; −.0001)
Self-rated health	.0034 (.0023; .0046)	−.0022 (−.0031; −.0014)	−.0006 (−.0013; .0001)	−.0019 (−.0028; −.0011)	−.0036 (−.0048; −.0025)
Direct effect[b]	.06 (.02)	−.09 (.02)	−.16 (.02)	−.06 (.02)	−.06 (.02)
	$p < .001$	$p < .001$	$p < .001$	$p < .001$	$p < .001$
WLSS					
Depressive symptoms	.0061 (.0022; .0102)	−.0038 (−.0062; −0017)	−.0015 (−.0030; −.0003)	−.0057 (−.0084; −.0031)	−.0058 (−.0090; −.0029)
Physical activity	.0000 (−.0003; .0003)	−.0001 (−.0005; .0002)	−.0001 (−.0004; .0002)	−.0001 (−.0005; .0001)	.0000 (−.0004; .0002)
Chronic conditions	.0007 (−.0004; .002)	−.0005 (−.0017; .0004)	.0009 (.0001; .0019)	−.0004 (−.0012; .0002)	−.0006 (−.0017; .0003)
Self-rated health	.0007 (−.0001; .0017)	−.0006 (−.0016; .0002)	−.0005 (−.0015; .0002)	−.0005 (−.0012; .0001)	−.0008 (−.0019; .0002)
Direct effect[b]	.11 (.03)	−.16 (.03)	−.17 (.03)	−.02 (.03)	−.07 (.03)
	$p < .001$	$p < .001$	$p < .001$	$p = .50$	$p = .02$

Note. Midlife in the United States Study (MIDUS): $N = 5{,}873$; Health and Retirement Study (HRS): $N = 10{,}473$; English Longitudinal Study of Aging (ELSA) = 5,718; National Health and Aging Trends Study (NHATS): $N = 2{,}380$; Wisconsin Longitudinal Study Graduate (WLSG): $N = 3{,}713$; Siblings (WLSS): $N = 1{,}295$.
[a] Bootstrap estimates and 95% bias-corrected confidence interval for indirect effects of personality traits on subjective age through self-rated health, physical activity, depressive symptoms, and chronic conditions, controlling for age, sex, education, and race (except for the WLSG and WLSS). [b] Direct effect (standard errors in parentheses) of personality traits on subjective age adjusted for mediators, age, sex, education, and race (except for the WLSG and WLSS); Coefficients are standardized regression coefficient.

higher self-rated health, lower depressive symptoms, and to a lesser extent through fewer chronic conditions and higher physical activity. Finally, the association between both higher openness and agreeableness and a younger subjective age was mediated through better self-rated health and lower depressive symptoms. Overall, the analysis indicated partial mediation: the association between personality and subjective age was reduced but remained significant when the mediators were included (Table 3).

There was little replicable evidence for an interaction between personality and age across the six samples. In the MIDUS, conscientiousness and openness were related to a younger subjective age at all ages, but the association was relatively stronger at older ages for both conscientiousness ($\beta_{interaction} = -.04$, $SE = 0.01$, $p = .003$) and openness ($\beta_{interaction} = -.04$, $SE = 0.01$, $p = .003$). In HRS, neuroticism was related to an older subjective age at all ages, but it was relatively stronger at younger ages ($\beta_{interaction} = -.02$, $SE = 0.009$, $p = .01$). In addition, extraversion ($\beta_{interaction} = .02$, $SE = 0.009$, $p = .008$), openness ($\beta_{interaction} = .02$, $SE = 0.009$, $p = .046$) and conscientiousness ($\beta_{interaction} = .02$, $SE = 0.009$, $p = .03$) were more strongly related to a younger subjective age among the younger HRS participants. In ELSA, extraversion was more strongly related to a younger subjective age among younger participants in the sample ($\beta_{interaction} = .03$, $SE = 0.01$, $p = .008$).

The results of the longitudinal analyses using MLM in HRS, MIDUS, and NHATS are in Table 4. Consistent with the cross-sectional results, the meta-analysis revealed that neuroticism was positively related to the intercept of subjective age, whereas extraversion, openness, agreeableness, and conscientiousness were negatively related to the intercept in the three samples (Table 4): higher neuroticism was related to an older subjective age, whereas higher extraversion, openness, agreeableness, and conscientiousness were associated with younger subjective age. Changes in subjective age were in the direction of an older subjective age-or less young subjective age- in the HRS ($b = .02$, $p < .001$) and the NHATS ($b = .03$, $p < .001$) and were in the direction of a younger subjective age in the MIDUS ($b = -.007$, $p < .001$). However, in contrast to the hypotheses, the meta-analysis indicated that extraversion, agreeableness, and conscientiousness were positively related to changes in subjective age, whereas neuroticism was negatively related to change in subjective age (Table 4). Openness was unrelated to the slope of subjective age. These findings suggest that lower neuroticism and higher extraversion, agreeableness, and conscientiousness were related to an increasingly older subjective age over time. There was some heterogeneity across the samples, with significant associations in the MIDUS and HRS but not in the NHATS. Figure 1 shows that changes in subjective age were very small. Figure 1 presents changes in the proportional discrepancy score for individuals with high (1 *SD* above the mean) and low (1 *SD* below the mean) neuroticism, extraversion, agreeableness, openness, and conscientiousness in the three samples. While the intercept effects are clearly visible, there are small differences between the slopes.

Discussion

Based on six large samples that included more than 30,000 middle-aged and older adults, the present study examined the relationship between personality and subjective age. As hypothesized, higher neuroticism was related to an older subjective age. In contrast, higher extraversion, openness, and conscientiousness were

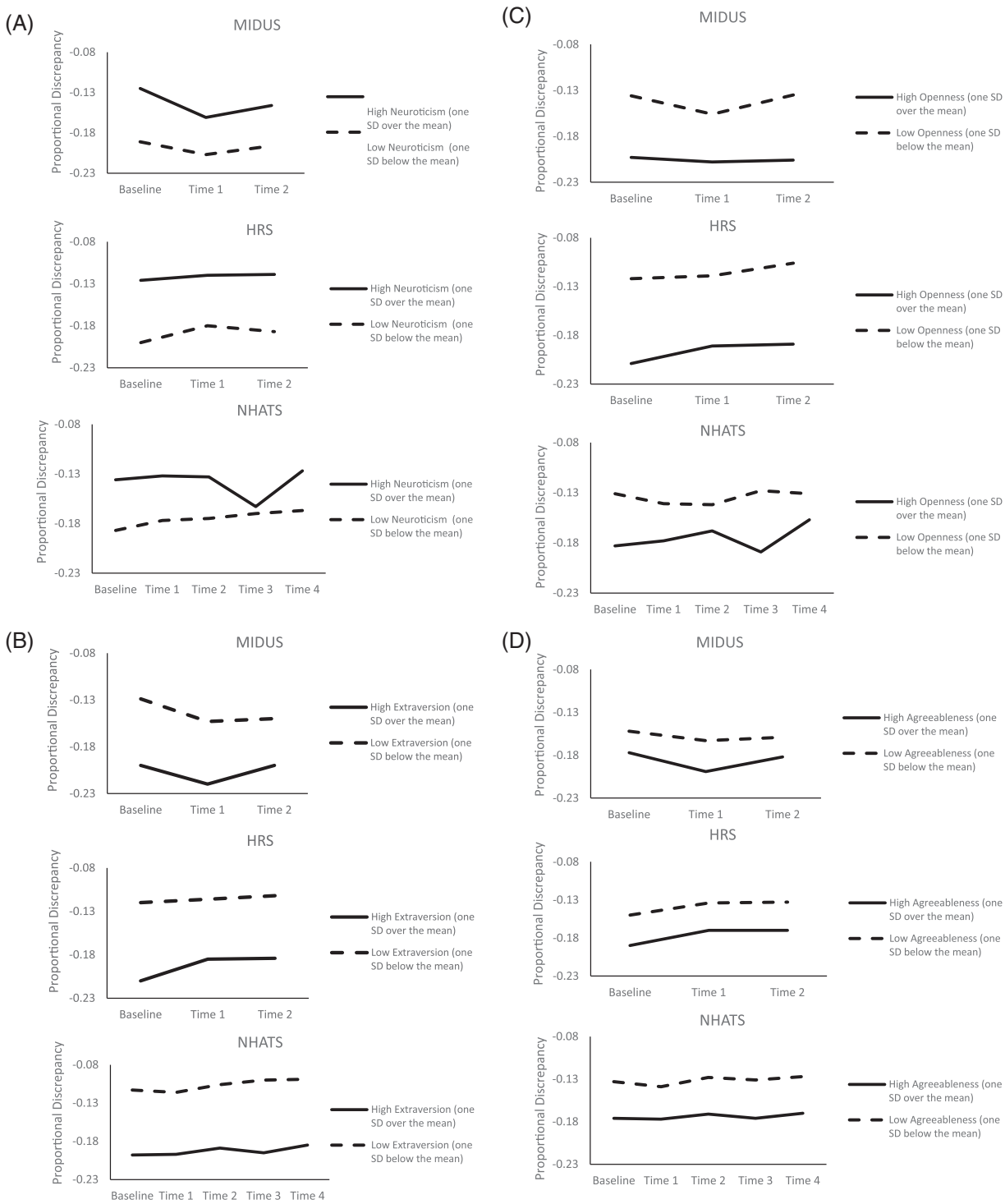
Table 4
Summary of Multilevel Analysis Predicting Change in Subjective Age From Baseline Personality Traits

Samples	Neuroticism		Extraversion		Openness		Agreeableness		Conscientiousness	
	Intercept	Slope	Intercept	Slope	Intercept	Slope	Intercept	Slope	Intercept	Slope
MIDUS	.02 (.002)	−.010 (.001)	−.02 (.002)	.006 (.001)	−.02 (.002)	.001 (.001)	−.02 (.002)	.004 (.001)	−.01 (.002)	.003 (.001)
	$p < .001$	$p < .001$	$p < .001$	$p < .001$	$p < .001$	$p = .29$	$p < .001$	$p = .004$	$p < .001$	$p = .018$
HRS	.03 (.001)	−.01 (.002)	−.03 (.001)	.02 (.002)	−.03 (.001)	.010 (.002)	−.02 (.001)	.009 (.002)	−.03 (.001)	.010 (.002)
	$p < .001$	$p < .001$	$p < .001$	$p < .001$	$p < .001$	$p < .001$	$p < .001$	$p < .001$	$p < .001$	$p < .001$
NHATS	.02 (.003)	−.02 (.008)	−.02 (.003)	.000 (.008)	−.02 (.003)	.009 (.008)	−.02 (.003)	.007 (.008)	−.01 (.003)	.009 (.008)
	$p < .001$	$p = .06$	$p < .001$	$p = .91$	$p < .001$	$p = .25$	$p < .001$	$p = .38$	$p < .001$	$p = .26$
Random effect	.02 (.01; .03)	−.01 (−.01; −.008)	−.03 (−.03; −.02)	.009 (.0007; .017)	−.03 (−.033; −.019)	.006 (−.001; .01)	−.02 (−.02; −.014)	.006 (.002; .010)	−.02 (−.03; −.007)	.006 (.001; .01)
	$p < .001$	$p < .001$	$p < .001$	$p = .03$	$p < .001$	$p = .10$	$p < .001$	$p = .002$	$p < .001$	$p = .02$
Heterogeneity Tau	.007	.002	.006	.006	.006	.005	.002	.002	.008	.004

Note. MIDUS = Midlife in the United States Study; HRS = Health and Retirement Study; NHATS = National Health and Aging Trends Study. Coefficients are unstandardized coefficients (standard errors in parentheses). 95 % confidence intervals are in parentheses for the random effect. Adjusted for age, sex, education, and race.

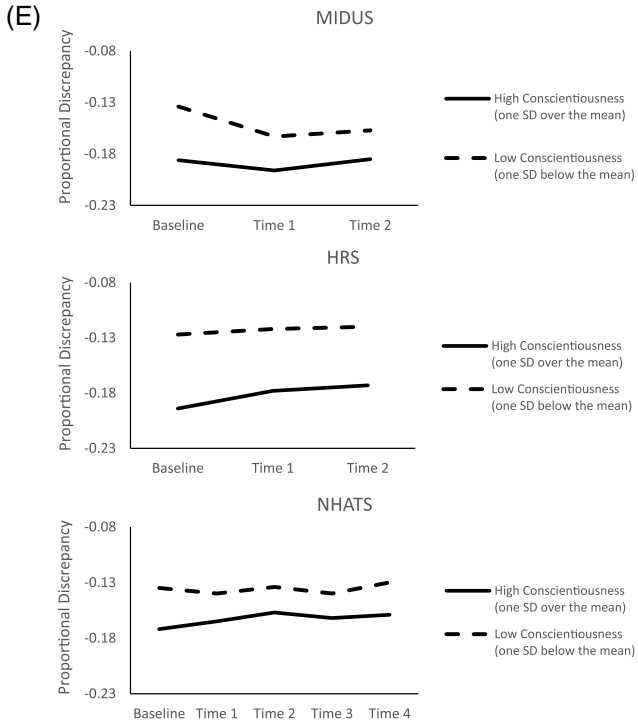
Figure 1

Changes in Subjective Age for Low and High Neuroticism (Panel A), Extraversion (Panel B), Openness (Panel C), Agreeableness (Panel D), and Conscientiousness (Panel E) in the MIDUS, the HRS, and the NHATS



Note. MIDUS = Midlife in the United States Study; HRS = Health and Retirement Study; NHATS = National Health and Aging Trends Study.

Figure 1 (*continued*)



related to a younger subjective age. Although we did not expect an association for agreeableness, this trait was associated with feeling younger. These associations replicated across most samples and were partially mediated by health and behavioral factors. In contrast to the hypotheses, the longitudinal analyses indicated that in two of three samples tested, lower neuroticism and higher extraversion, agreeableness, and conscientiousness were related positively to the slope of subjective age (i.e., feeling increasingly older over time). Although statistically significant, the associations between the traits and the slope were very small. In addition, the association between personality and subjective age was relatively independent of chronological age. This study contributes to existing knowledge on the biopsychosocial nature of subjective age by providing the largest study to date and metaanalytic estimates of the associations between personality as a psychological disposition and subjective age as an indicator of subjective aging processes. It also identifies mediators and provides the first longitudinal evidence of the relationship between personality and changes in subjective age over a time span that ranged from 4 to 20 years.

Neuroticism was consistently related to an older subjective age in the cross-sectional analysis. Although most previous cross-sectional studies did not find an association between neuroticism and subjective age (Canada et al., 2013; Hubley & Hultsch, 1996; Stephan et al., 2012), the current research reports a positive association in all six samples. The basic tendencies associated with neuroticism may be reflected in subjective age. Indeed, neuroticism is characterized by a propensity to experience intense and frequent negative affect, such as distress and anxiety, that contributes to feeling older (Kotter-Grühn et al., 2015a). Individuals higher in neuroticism might also be sensitive to negative age-related information in the environment (Kornadt et al., 2019), increasing felt age. Furthermore, the mediation analysis indicated that neuroticism is related to subjective age, in part, through health-related and behavioral pathways. Higher neuroticism, for example, is associated with more functional limitations (Canada et al., 2021), poor self-rated health (Stephan, Sutin, Luchetti, et al., 2020), and lower physical activity (Sutin et al., 2016) that are likely to lead to an older subjective age (Barrett & Gumber, 2020; Spuling et al., 2013; Stephan et al., 2015a; Stephan, Sutin, & Terracciano, 2020). Consistent with this theoretical framework, additional analyses indicated that the association between neuroticism and concurrent older subjective age was in part mediated by lower self-rated health, higher chronic conditions, higher depressive symptoms, and physical inactivity. There are other health-related factors that may also explain this association, such as through higher body mass index (BMI), which is associated with both neuroticism (Sutin & Terracciano, 2016) and an older subjective age (Stephan, Sutin, & Terracciano, 2019). Neuroticism may also be related to subjective age through social-related pathways, such as through greater loneliness, which again is associated with both higher neuroticism (Buecker et al., 2020) and an older subjective age (Ayalon et al., 2016). Finally, shared genetic factors could also explain part of the association between higher neuroticism and an older subjective age (Stephan, Sutin, Kornadt, et al., 2019).

Across most samples and the meta-analysis, higher extraversion, openness, and conscientiousness were associated with a younger subjective age at baseline. This finding supports previous research on extraversion and subjective age (Hubley & Hultsch, 1996; Stephan et al., 2012; Weiss et al., 2019) and adds to the currently mixed literature on conscientiousness (Knoll et al., 2004; Stephan et al., 2012). It is likely that subjective age may reflect the basic

tendencies of traits like extraversion and openness. Indeed, extraversion is defined as a tendency to experience positive emotions, which are reflected in a younger subjective age (Kotter-Grühn et al., 2015a). Similar to neuroticism, additional analyses indicated that better self-rated health, lower chronic conditions, lower depressive symptoms, and more frequent physical activity explained part of the association between these traits and a younger subjective age. In addition, extraversion, openness, and conscientiousness are associated with better physical functioning (Canada et al., 2021), which is related to a younger subjective age (Barrett & Gumber, 2020). Furthermore, conscientiousness is related to lower BMI (Sutin & Terracciano, 2016), which is consistently associated with feeling younger (Stephan, Sutin, & Terracciano, 2019). Finally, extraversion, openness, and conscientiousness are associated with less loneliness (Buecker et al., 2020), which might also affect subjective age (Ayalon et al., 2016).

Unexpectedly, agreeableness was related to a younger subjective age in the meta-analysis and five out of six samples. This study provides the first evidence for an association between agreeableness and subjective age. The better health and behavioral profiles of agreeable individuals (Canada et al., 2021; Stephan, Sutin, Luchetti, et al., 2020; Sutin et al., 2016) may explain their younger subjective age, as suggested by the mediation analysis. Furthermore, agreeable individuals' prosocial orientations may lead them to engage in positive social interactions, leading to lower loneliness (Buecker et al., 2020), which may foster a younger subjective age.

In addition to the behavioral and clinical mechanisms tested in this study, theoretical formulations of subjective age suggest that social comparison processes may also explain the link between personality and subjective age. For example, experimental and correlational studies indicate that more favorable comparisons of one's physical and cognitive functioning with same-age peers lead to a younger subjective age (Hughes & Lachman, 2018; Stephan et al., 2013). As a result, it is likely that individuals higher in neuroticism may feel older in part because they may perceive that they experience worse health, cognition, and more distress and negative emotions than their peers who are lower in neuroticism. In addition, extraverted, open, agreeable, and conscientious individuals may feel younger because they perceive themselves in better health than their same-age peers. As a whole, extraverted, open, agreeable, and conscientious individuals may behave, feel, and think more like their younger counterparts, leading to feeling closer in age to these counterparts than those of the same chronological age.

The MLM analysis on the association between personality and the intercept of subjective age was consistent with the cross-sectional analysis: higher neuroticism was related to an older subjective age, whereas higher extraversion, openness, agreeableness, and conscientiousness were associated with feeling younger. The association with the slope, however, was unexpected. In contrast to the hypothesis, higher neuroticism was associated with an increasingly younger subjective age over time, whereas extraversion, agreeableness, and conscientiousness were related to feeling increasingly older over time. These associations were relatively weak when compared to the concurrent associations.

Consistent with a distancing hypothesis, recent research has found that individuals feel increasingly younger over time as a self-protective process of psychologically distancing from the vulnerability associated with old age (Terracciano et al., 2021). Because of their propensity to experience distress and negative emotions, individuals with a more vulnerable personality profile (e.g., higher neuroticism) may be more vulnerable to age-related threats, and as a result may be more likely to use such coping mechanisms. In contrast, extraverted, agreeable, open, and conscientious individuals may be less vulnerable to such threats. Furthermore, there is an optimal margin to the subjective age bias (Blöchl et al., 2021). Specifically, feeling younger is beneficial to life satisfaction up to a certain limit, and this optimal margin changes across adulthood (Blöchl et al., 2021). Blöchl et al. (2021) found that the optimal margin is higher among older adults, when the discrepancy between felt age and chronological age is measured in years. However, when the proportional discrepancy is computed, this optimal margin tends to decrease. Therefore, it is likely that the relationship between higher extraversion, openness, agreeableness, and conscientiousness, and the reduced younger subjective age over time may be reflective of a regulation process that aims to maintain an optimal margin of feeling younger and maximizing life satisfaction. In contrast, individuals with higher neuroticism may be more likely to hold unrealistic perceptions of their age over time because of their high distress. It should be noted that the very small associations observed between personality and rate of change may also simply indicate regression to the mean.

We did not find strong evidence that age moderated the association between personality and subjective age. It might be the case that more dispositional variables influence subjective age alike throughout the life span. However, given the close linkage of subjective age with the life course and its structure, future studies should investigate the possibility of nonlinear relationships and also sensitive developmental phases in which subjective age might be more strongly affected by personality traits (e.g., Kornadt et al., 2019).

The present study has theoretical implications. It contributes to the conceptualization of subjective age as a biopsychosocial marker of aging that tracks and encapsulates a range of factors, from biomedical to environmental (Stephan et al., 2015a; Thyagarajan et al., 2019; Weiss & Weiss, 2019). The present study provides replicable and robust evidence that age felt is related to individuals' characteristic ways of thinking, feeling, and behaving. In particular, this study indicates that feeling older than one's age is more common among people with higher neuroticism and lower conscientiousness. This finding could advance the understanding of the association observed between an older subjective age and both higher risk of dementia (Stephan, Sutin, Luchetti, et al., 2018) and mortality (Rippon & Steptoe, 2015; Stephan, Sutin, & Terracciano, 2018). Higher neuroticism and lower conscientiousness are also robust predictors of dementia (Aschwanden et al., 2021) and mortality (Graham et al., 2017). An older subjective age over time may represent an important factor in the pathways between enduring personality traits and risk of dementia and mortality. Furthermore, this study extends existing models of personality and health (Friedman & Kern, 2014) by showing that individual differences in personality are associated with subjective age, a crucial construct in gerontology with implications for older adults' identity, health, and well-being.

The present study has several strengths, including the use of six large samples of middle-aged and older adults, the assessment of all five major personality traits, the consideration of potential mediators, and the longitudinal test of the link between personality and subjective age over up to 20 years. There are also several limitations. Causality cannot be established with an observational design.

Although personality may predict subjective age, reciprocal relationships may also exist. Indeed, subjective age has also been found to predict changes in personality (Stephan et al., 2015b). Furthermore, behavioral and clinical factors were modeled as mediators of personality and subjective age, but it is also likely that subjective age is a mediator of the link between personality and behavioral and clinical outcomes. This study includes mostly American samples and only one European sample. More research is needed to identify whether the pattern of relationship between personality and subjective age generalizes across samples from different cultures. Future research may also examine the specific personality facets associated with subjective age, as well as the link between personality and specific facets of subjective age (Kornadt et al., 2018). The low internal consistency of the personality scales was another limitation of the present study.

Finally, the association between personality and subjective age has been examined in past research using some of the datasets included in the present study (see Supplemental Table S3). However, the cross-sectional and longitudinal associations between personality and subjective age examined in the present study have never been tested in past research using each of these samples. In particular, past research has mostly focused on personality traits as mediating variables of the link between predictors and subjective age (Stephan, Sutin, Kornadt, et al., 2018; Stephan, Sutin, & Terracciano, 2020) or have focused on one trait (Weiss et al., 2019) and have used different waves of personality measurement (Supplemental Table 3). The examination of six samples reduces potential overfitting problems because it attenuates the effect of any peculiarities specific to a given sample. Here we focused on the most replicable associations.

In sum, the present study found replicable relations between personality and subjective age. Higher neuroticism was related to an older subjective age, whereas extraversion, openness, agreeableness, and conscientiousness were related to a younger subjective age. This study contributes to existing knowledge on the psychological factors associated with subjective age.

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