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High-Quality Relationships Strengthen the Benefits of a Younger Subjective Age Across Adulthood

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Feeling younger than one's chronological age—a younger subjective age bias—has been consistently linked to healthy aging. However, little is known about conditions under which such benefits are strengthened. In high-quality relationships, partners affirm individuals' self-views and offer support that can encourage individuals to engage in behaviors compatible with their subjective age. Thus, we hypothesized the benefits of a younger subjective age bias would be stronger among adults in high-quality relationships. Hypotheses were supported in a 10-year longitudinal study of married adults (ages 34–84; $N > 600$): Relationship quality moderated the effect of subjective age bias on memory performance and heart rate variability, such that individuals in higher-quality relationships showed stronger beneficial effects of a younger subjective age bias. Results suggest psychological and relational resources may work together to jointly influence healthy aging.

Keywords: subjective age bias, relationship quality, heart rate variability, memory performance, MIDUS

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There is solid evidence that in the second half of life, feeling younger than one's chronological age (a younger subjective age bias) is linked to benefits to health, performance, and well-being (Kotter-Gruhn, Kornadt, & Stephan, 2015; Montepare, 2009; Westerhof et al., 2014). For example, adults with a younger subjective age experience better cognitive health (Stephan, Sutin, Luchetti, & Terracciano, 2017), including better episodic memory, despite normative age-related declines (Stephan, Sutin, Caudroit, & Terracciano, 2016). In addition, a younger subjective age bias can protect against inflammatory markers associated with heart disease (Stephan, Sutin, & Terracciano, 2015), suggesting that feeling younger may benefit heart health and play a role in protecting individuals from cardiovascular disease risk. Ultimately, having a younger subjective age bias may be important for helping older adults counteract declines associated with aging (Stephan, Sutin, & Terracciano, 2016; Teuscher, 2009; Weiss & Lang, 2012; Weiss, Sassenberg, & Freund, 2013; Westerhof et al., 2014).

There are multiple routes through which a younger subjective age bias may be related to healthy aging (Wurm, Diehl, Kornadt, & Westerhof, 2017). More specifically, these routes include (a) physiological (e.g., C-reactive protein), (b) psychological (e.g., depression), and (c) behavioral pathways (e.g., physical activity; see Stephan, Caudroit, Jaconelli, & Terracciano, 2014; Stephan et al., 2015). It has been argued that subjective age biases reflect individuals' perceptions of their own aging, with younger subjective age biases reflecting more positive self-perceptions of aging. Moreover, empirical work has suggested that feeling younger is an adaptive, self-protective strategy that adults use to maintain self-esteem and positive views of the self as they are increasingly confronted with aging-related losses (Heckhausen & Brim, 1997; Teuscher, 2009). Supporting this interpretation, experimental studies have revealed that older adults temporarily report a larger subjective age bias and more distancing from their chronological age group when negative views regarding aging are activated Weiss & Freund, 2012; Weiss & Lang, 2012). In addition, results show that a younger subjective age bias is linked to higher levels of well-being and self-esteem (Armenta, Scheibe, Stroebe, Postmes, & Van Yperen, 2018; Weiss et al., 2013). Finally, having a younger subjective age bias may also foster psychological mindsets that help individuals deploy constructive coping strategies when facing difficult situations or simply adjusting to the physical and cognitive changes that accompany normal aging (Weiss & Kornadt, 2018).

Despite the benefits associated with a younger subjective age bias, little work has revealed conditions under which such benefits may be strengthened. Some work has considered moderating con-

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ditions (Mock & Eibach, 2011; Stephan, Demulier, & Terracciano, 2012), yet these investigations have largely focused on intraindividual factors, such as chronological age and aging attitudes. Therefore, in the current research we focus on how the interplay between subjective age bias and a key aspect of one's social life—specifically, the quality of one's marital relationship—might be linked to indicators of healthy aging across adulthood.

Importance of High-Quality Relationships for Health and Well-Being

Social relationships are a central part of life and are among the most important predictors of health and mortality (Holt-Lunstad, 2018). Relationships also offer resources that help individuals adapt to changes they encounter across development (Antonucci, Ajrouch, & Birditt, 2014; Uchino, Ong, Queen, & Kent De Grey, 2016).

In particular, the quality of marital relationships has emerged as an important predictor of health throughout adulthood, and associations between marital relationship quality and health have been found both concurrently and longitudinally spanning a range of age groups (Robles, Slatcher, Trombello, & McGinn, 2014). Although some work has suggested links between marital status and well-being, with some reports suggesting married people enjoy health benefits over their unmarried counterparts (Johnson, Backlund, Sorlie, & Loveless, 2000), there is accumulating evidence demonstrating that marital quality may be more consequential for health than marital status alone (Gove, Hughes, & Style Briggs, 1983; Holt-Lunstad, Birmingham, & Jones, 2008). For example, one investigation showed that higher marital relationship quality was linked to indicators of physical and psychological health (e.g., lower ambulatory blood pressure, lower stress; Holt-Lunstad et al., 2008). Moreover, this study also found that participants in lower-quality marriages had higher blood pressure (possibly indicating poorer cardiovascular health) compared to single participants, reinforcing the importance of considering relationship quality in investigations of marital relationships and health.

Drawing on such findings, the Strength and Strain Model of Marital Quality and Health (Slatcher & Selcuk, 2017) was recently proposed to account for the diverging associations between marital status and health for people in higher- versus lower-quality relationships. Broadly, the Strength and Strain Model posits that marital relationships involve both positive features (e.g., social support) that provide individuals with sources of "strength," as well as negative features (e.g., conflict) that incur "strain." Higher-quality relationships are characterized by stronger positive features of relationships, which in turn protect and enhance health. By contrast, lower-quality relationships are characterized by negative features of relationships, which can compromise health.

How Might High-Quality Relationships Affect Healthy Aging?

Although it is known that relationship quality is important for health (Robles et al., 2014), research on relationship quality has not, to our knowledge, been considered as a potential moderator of outlooks on aging, in particular, subjective age bias.

There are key ways in which relationship quality might be related to healthy aging. In particular, relationship partners validate core features of the self (Reis & Gable, 2015), especially the "ideal self," or the person that one aspires to become (Hoppmann, Gerstorf, Smith, & Klumb, 2007; Rusbult, Finkel, & Kumashiro, 2009; Rusbult, Kumashiro, Kubacka, & Finkel, 2009). Ideal self-views are a key motivator of behaviors that influence healthy aging, and people continue to have ideal selves in older adulthood (Frazier, Hooker, Johnson, & Kaus, 2000). Through this process of partner affirmation, high quality relationships elicit behaviors that are compatible with people's self-views (Drigotas, Rusbult, Wieselquist, & Whitton, 1999; Rusbult et al., 2009). For example, if Paul sees himself as (or aspires to be) "young at heart," Margaret may provide encouragement that will prompt Paul to enact behaviors congruent with his self-view. Margaret may accomplish this by engaging in joint activities with Paul (e.g., trying a new fitness class with him), validating his self-view (e.g., complimenting his youthful appearance), or enacting behaviors herself that can help Paul realize his younger self-view (e.g., preparing healthy meals for him; Fitzsimons, Finkel, & VanDellen, 2015). In turn, high quality relationships have important implications for goal pursuit and behavior both concurrently and longitudinally (Kumashiro, Rusbult, Finkenauer, & Stocker, 2007; Rusbult et al., 2009).

Furthermore, high quality relationships provide a source of companionship, which encompasses positive, everyday aspects of interpersonal relationships that are not tied directly to a specific event or goal (Rook, 1987). This could include quality time spent together, which could offer a respite from minor hassles (Rook, 2015).

In addition to helping individuals realize important goals and self-enhancement, high-quality relationships also offer strengths in times of adversity (Feeney & Collins, 2015). In such circumstances, high-quality relationships can buffer individuals from the negative effects of stress. While stressors may undermine healthy aging by increasing wear-and-tear on physical and psychological well-being, having responsive social support from close others, especially one's spouse, can help offset these tolls (Selcuk & Ong, 2013; Uchino, 2009).

In contrast, these features are less apparent in lower-quality relationships. In lower-quality relationships, partners may fail to affirm, or may even undermine, each others' efforts to enact behaviors and pursue goals congruent with their self-view. For example, in a low-quality relationship, Margaret might ignore opportunities to support Paul or explicitly disaffirm Paul's self-view (e.g., by making disparaging comments about his attempts to engage in activities important for healthy aging, or reminding him that he is not getting younger). Low-quality relationships are also often characterized by inconsistent or ambivalent caregiving, with individuals finding their partner both helpful and upsetting. This in turn is associated with poorer markers of cardiovascular health (e.g., higher coronary calcification, lower resting heart rate variability; Holt-Lunstad, Uchino, Smith, & Hicks, 2007; Uchino, Smith, & Berg, 2014).

Do High-Quality Relationships Strengthen the Benefits of a Younger Subjective Age Bias?

Given the importance of high-quality relationships for healthy aging (Holt-Lunstad, 2018; Robles et al., 2014; Uchino et al., 2016), the benefits of a younger subjective age bias may be intensified among individuals in such relationships. Higher-quality relationships can provide affirmation and validation important for realizing a younger self-view and can also provide support and companionship to offset the negative effects of stress.

We posit that investigating the potential interactive role of marital relationship quality is an important next step in research on subjective age. We note that some previous research has considered the interplay between subjective age bias and marital status. One study tested whether married versus unmarried adults differ in their subjective age, but generally found that marital status was unrelated to subjective age (Henderson, Goldsmith, & Flynnm, 1995). Importantly, another investigation tested for interaction effects between subjective age bias and marital status, but did not find evidence for such effects (Stephan et al., 2014, p. 1183). This lack of evidence in favor of stronger subjective age bias effects among married individuals is consistent with the Strength and Strain Model, because marital relationships can pose both protective and enhancing factors as well as risk factors for health. Despite its potential importance, we are not aware of research that has investigated whether effects of subjective age bias depend on relationship *quality*. Thus, among adults in marital (or marriage-like) relationships, those in higher-quality relationships should experience stronger benefits of having a younger subjective age bias.

Overview of Research

This research takes a novel approach to understanding the beneficial effects of having a younger subjective age bias by investigating whether this psychological resource (i.e., subjective age younger than one's chronological age) interacts with interpersonal resources (i.e., relationship quality) to benefit cognitive functioning and cardiovascular health over time. More specifically, this study investigated whether the benefits of a younger subjective age bias would be stronger among individuals in high-quality relationships.

We were also interested in whether these interactive effects would persist both concurrently and longitudinally. Previous research has found longitudinal benefits of subjective age bias over the span of decades (Westerhof et al., 2014), thus we were interested whether interactive effects would hold over time. Similarly, research on the links between marital quality and health have also found both concurrent and longitudinal associations (Robles et al., 2014). Examining effects at two timepoints was also theoretically plausible, as the passing of time might allow the benefits of high-quality relationships, and the costs of low-quality relationships, to accumulate. In sum, we anticipated that there would be both longer-term (10 years) and shorter-term (0–2 years) benefits of the interactive effects of subjective age bias and relationship quality, although we did not have specific a priori predictions about whether the strength of these effects would increase or decrease with time. We also examined potential age differences in the dynamic interplay of subjective age bias and relationship quality on cognitive functioning and cardiovascular health, given that age differences have been previously examined in studies of subjective age (Stephan et al., 2012).

Interactive Effects of Subjective Age Bias and Relationship Quality

Given prior work (Stephan et al., 2014; Westerhof et al., 2014), we hypothesized that feeling younger would be associated with markers of better cognitive and cardiovascular health, namely better memory performance and lower resting heart rate variability. Moreover, we hypothesized that these benefits would depend on relationship quality, such that a younger subjective age bias would be more strongly linked to these markers of cognitive and cardiovascular health among adults in higher-quality relationships.

Health Outcomes

Potential implications for cognitive health. First, we were interested in potential interactive effects on cognitive health, specifically memory performance. Memory performance has been examined in numerous studies of subjective age bias (e.g., Stephan et al., 2016), as well as in other studies of aging perceptions and attitudes. Memory performance is important for healthy aging given that it normatively declines with age and is a domain in which older adults face negative stereotypes. Although relationship quality and links to memory declines with age have not been a major focus of work in the relationships literature, relationship quality could work interactively with a younger subjective age bias in this domain.

Potential implications for cardiovascular health. Second, we examined implications for cardiovascular health, specifically resting heart rate variability. Heart rate variability (HRV) captures the regularity of the length of intervals between heartbeats and reflects the flexibility of the autonomic nervous system to regulate cardiac activity (Appelhans & Luecken, 2006). Greater variability (higher HRV) has been associated with beneficial social, psychological, and physiological outcomes (Muhtadie, Koslov, & Mendes, 2015; Porges, 1995). Of particular relevance to this investigation, resting HRV has also been linked to prospective heart health. Decreases in resting HRV precede the onset of cardiovascular disease (e.g., hypertension; Schroeder et al., 2003; Tsuji et al., 1996), which made it an especially suitable measure of cardiovascular health to use in an age-diverse sample, such as the one we examined.

Method

We tested the hypothesized interactive effects of subjective age bias and relationship quality using data from the Midlife in the United States (MIDUS) study, a national study of adults residing in the United States (Brim, Ryff, & Kessler, 2004). Data to test our hypotheses came from MIDUS I (Wave 1), MIDUS II (Wave 2), the MIDUS Cognitive Project, and the MIDUS Biomarker Project. MIDUS I was conducted in 1995–1996 (n = 7108), MIDUS II (n = 4963) and the MIDUS Cognitive Project (n = 4512) were conducted in 2004–2006, and the MIDUS Biomarker Project (n = 1255) was conducted in 2004–2009.

In the current study, we used data from more than 600 participants (ages 34–84) who were married or in a marriage-like relationship who (a) reported their chronological age, subjective age, and the quality of their relationship with their spouse/partner in both waves and participated in the (b) Cognitive Project and (c)

Biomarker Project. Overall, there were 678 unique participants who contributed data to at least one of the analyses presented below, and there were 567 participants who contributed data to all of the analyses.

Procedure and Materials

MIDUS participants responded to questions about their felt age, relationship quality, and other demographic variables as part of a telephone interview. Memory performance was also assessed via telephone, as described below. Resting heart rate variability was measured during a laboratory visit at one of three sites across the United States.

Subjective age. In Waves 1 and 2, subjective age was assessed by asking participants how old they felt most of the time. Answers were reported in years. One observation from each wave fell more than 4 standard deviations above the mean; these observations were removed prior to analysis.

Relationship quality. In Waves 1 and 2, participants indicated the quality of their relationship with their spouse or partner ("Would you describe your relationship as . . .?") using a scale ranging from 1 (*Excellent*) to 5 (*Poor*). For clarity of interpretation, values were reverse scored, such that higher numbers correspond to higher relationship quality.

Memory performance. To gauge cognitive benefits, we examined participants' performance on an episodic memory task administered as part of the MIDUS Cognitive Project. The memory performance task was included as part of a larger battery of cognitive tasks that was administered by computer-assisted telephone interview. Participants were presented with a word list (15 words, e.g., "drum," "farmer," "moon"), with a 1-s interval between each word. Both immediate and delayed recall were measured by asking participants to repeat back as many words as they could remember. Immediate and delayed recall were combined into a single composite of memory performance and are presented in standard deviation (z-score) units. More details regarding this task can be found on the MIDUS Cognitive Project web page (Ryff & Lachman, 2017) and in other publications (e.g., Stephan et al., 2014).

Resting heart rate variability (HRV). To assess cardiovascular health, we examined resting high-frequency heart rate variability (HRV), which was measured during the MIDUS Biomarker Project. HRV was measured in two 300-s epochs. Due to the high correlation between HRV measurements (r = .93), the two were averaged, and log transformed values are presented in this article and used in the analyses. For details regarding HRV measurements and data collection, see details on the MIDUS Biomarker Project web page (Ryff, Seeman, & Weinstein, 2018) and work by Dienberg Love, Seeman, Weinstein, and Ryff (2010). Respiration was also measured; however, results for HRV did not change appreciably when controlling for respiration.

Covariates. For the purposes of this article, selected covariates were those related to key demographic dimensions and those that were plausibly related to our outcomes. The majority of the covariates selected have been used in prior publications analyzing data from the Cognitive and Biomarker Projects (e.g., Stephan et al., 2014; Weiss & Weiss, 2016). Demographic variables were gender (−.5 = female, .5 = male) and education level; the latter was included given consistent associations between higher levels of education and better cognitive performance. Subjective health (how participants perceived their own health) was also included, given that it has been previously examined in research on subjective age bias (Stephan, Caudroit, & Chalabaev, 2011). Marriage length (in years) was also selected given that it was likely to be related to both relationship quality and age.

Variables measured during MIDUS Biomarker data collection that were related to physical health and cardiovascular status were also selected: diagnosis of heart disease (0 = no diagnosis, 1 = diagnosis), diagnosis of hypertension (0 = no diagnosis, 1 =

Table 1
Correlations Among Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
2	.78***															
3	.04	.08*														
4	.28***	.69***	.05													
5	.51***	.45***	−.01	.16***												
6	.61***	.88***	.06	.63***	.75***											
7	.10*	.19***	.50***	.22***	.08	.19***										
8	.26***	.66***	.10**	.93***	.14***	.60***	.18***									
9	.03	.13***	.11**	.10**	.01	.13**	.11**	.08*								
10	.00	−.03	−.02	−.04	.02	−.03	.00	−.03	.06							
11	.12**	.04	.03	−.05	.20***	.09*	.07	−.01	−.01	.14***						
12	−.04	−.03	−.08*	.02	−.03	−.02	−.03	−.01	.10*	−.07	−.24***					
13	.08*	.26***	.09*	.26***	.02	.23***	.12**	.22***	.16***	.01	−.23***	.05				
14	.08*	.22***	−.05	.22***	.04	.21***	.06	.21***	.01	−.02	−.24***	.24***	.19***			
15	.00	.08*	−.01	.08	.05	.10**	.00	.04	.13***	−.14***	−.12**	.03	.09*	.02		
16	−.16***	−.30***	.00	−.24***	−.10*	−.28***	−.02	−.20***	−.08*	.01	.12**	−.12**	−.06	−.10**	−.06	
17	−.16***	−.34***	−.08*	−.32***	−.09*	−.32***	−.10**	−.32***	−.36***	.17***	.13**	−.09*	−.20***	−.15***	−.09*	.16***

Note. 1 = Wave 1 Subj. Age Bias; 2 = Wave 1 Age Level; 3 = Wave 1 Rel. Quality; 4 = Wave 1 Rel. Length; 5 = Wave 2 Subj. Age Bias; 6 = Wave 2 Age Level; 7 = Wave 2 Rel. Quality; 8 = Wave 2 Rel. Length; 9 = Gender; 10 = Education; 11 = Subj. Health; 12 = Body Mass Index (BMI); 13 = Heart Disease; 14 = High BP; 15 = Smoker; 16 = Resting Heart Rate Variability; 17 = Memory Performance. Correlations draw on data from individuals included in our analyses (N = 678).
* $p < .05$. ** $p < .01$. *** $p < .001$.

diagnosis), smoker status (0 = not a current smoker, 1 = current smoker), and body mass index (BMI).

Description of Analytic Sample

As introduced previously, analyses drew on a subset of participants from the MIDUS project. In particular, the analytic sample was smaller than the full sample of MIDUS participants due to our inclusion of participants who were married or in a marriage-like relationship and our focus on HRV as an outcome, which was only measured among MIDUS Biomarker participants.

Selectivity Analyses

We first assessed whether participants included in our analytic sample differed significantly from those who were not on key dimensions: chronological age, subjective age bias (chronological age − subjective age, described in greater detail below), relationship quality, memory performance, and resting HRV. Summary statistics for these variables (means and standard deviations), test statistics, and effect sizes are displayed in Table S1 of the online supplemental materials.

Participants across subsamples did not differ in chronological age or subjective age bias. Participants in our analytic sample, on average, had better memory performance, lower resting HRV, and higher relationship quality at Wave 1 compared to those not included in our analytic sample. However, in all cases, these differences were marginally significant and were below the conventional threshold for small effect sizes (Cohen's $ds < |.14|$, where small effects are defined as Cohen's $d = .30$; Cohen, 1992). The gender composition differed marginally between the analytic sample and rest of the sample, $\chi^2(1, N = 4557) = 3.07, p = .08$. There was a more equal number of male and female participants in the analytic sample (male: $n = 336$; female: $n = 342$) compared to those not in the analytic sample (male: $n = 1778$; female: $n = 2101$).

Zero-order correlations among the variables assessed for this article using the analytic sample are provided in Table 1.

Attrition Analyses

We also examined whether there were differences within our analytic sample between participants who contributed data to all versus only some of our analyses (see online supplemental materials, Table S2). There were 111 participants who were included in

Table 2
Summary of Results for Episodic Memory Performance Showing Moderation of Subjective Age Bias by Relationship Quality (Measured at Wave 1), With Unstandardized Coefficients

Coefficient	Estimate	*SE*	*t*	*df*	*p*	Lower	Upper	Effect size	*SE*r
Intercept	.101	.033	3.09	639	.002	.037	.166		
Subj. Age Bias	.034	.007	4.72	639	<.001	.020	.049	.18	.04
Rel. Quality	−.044	.034	−1.30	639	.194	−.111	.023	.05	.04
Age Level	−.061	.007	−9.34	639	<.001	−.074	−.048	.35	.04
Intercept	.123	.038	3.22	635	.001	.048	.198		
Subj. Age Bias	.035	.007	4.68	635	<.001	.020	.049	.18	.04
Rel. Quality	−.060	.040	−1.52	635	.128	−.138	.017	.06	.04
Age Level	−.060	.007	−8.93	635	<.001	−.073	−.047	.33	.04
Subj. Age Bias × Rel. Quality	.020	.008	2.45	635	.014	.004	.036	.10	.04
Subj. Age Bias × Age Level	.000	.000	−.90	635	.368	−.001	.000	.04	.04
Age Level × Rel. Quality	−.014	.008	−1.79	635	.073	−.029	.001	.07	.04
Subj. Age Bias × Age Level × Rel. Quality	.000	.001	.23	635	.821	−.001	.001	.01	.04
Intercept	.087	.054	1.61	626	.108	−.019	.193		
Subj. Age Bias	**.015**	**.009**	**1.75**	**626**	**.080**	**−.002**	**.032**	**.07**	**.04**
Rel. Quality	−.039	.041	−.95	626	.342	−.121	.042	.04	.04
Age Level	−.034	.010	−3.29	626	.001	−.054	−.014	.13	.04
Subj. Age Bias × Rel. Quality	**.017**	**.008**	**2.24**	**626**	**.025**	**.002**	**.032**	**.09**	**.04**
Subj. Age Bias × Age Level	.000	.000	−.58	626	.561	−.001	.001	.02	.04
Age Level × Rel. Quality	−.012	.007	−1.73	626	.085	−.026	.002	.07	.04
Subj. Age Bias × Age Level × Rel. Quality	.000	.000	−.02	626	.985	−.001	.001	.00	.04
BMI	−.004	.006	−.66	626	.508	−.015	.007	.03	.04
Smoker	.015	.063	.24	626	.814	−.109	.139	.01	.04
Heart Disease	−.053	.099	−.54	626	.592	−.247	.141	.02	.04
High BP	−.069	.070	−.98	626	.325	−.206	.068	.04	.04
Gender	−.566	.064	−8.91	626	<.001	−.690	−.441	.34	.04
Education	.059	.013	4.63	626	<.001	.034	.083	.18	.04
Subj. Health	.069	.036	1.92	626	.056	−.002	.140	.08	.04
Wave 2 Rel. Quality	.010	.035	.30	626	.764	−.058	.079	.01	.04
Rel. Length	−.005	.004	−1.30	626	.194	−.013	.003	.05	.04

Note. $N = 643$. Effect size estimates are in units of r, where $r = \sqrt{t^2/(t^2 + df)}$. The sampling error for r is denoted SEr, where $SE\text{r} = 1/\sqrt{n-3}$. The top panel of the table shows results obtained from a model with main effect terms only for subjective age bias, relationship quality, and age level. The middle panel shows results obtained from a model with subjective age bias, relationship quality, age level, and all interaction terms. The bottom panel shows results obtained from a model with the same predictors as the middle panel plus covariates. Effects of interest are shown in bold text. Subj. = Subjective; Rel. = relationship; BMI = body mass index.

Table 3
Summary of Results for Heart Rate Variability Showing Moderation of Subjective Age Bias by Relationship Quality (Measured at Wave 1), With Unstandardized Coefficients

Coefficient	Estimate	*SE*	*t*	*df*	*p*	Lower	Upper	Effect size	*SE*r
Intercept	4.670	.047	99.12	599	<.001	4.577	4.762		
Subj. Age Bias	.032	.011	2.95	599	.003	.011	.053	.12	.04
Rel. Quality	.028	.048	.58	599	.560	−.066	.122	.02	.04
Age Level	−.068	.010	−7.08	599	<.001	−.087	−.049	.28	.04
Intercept	4.658	.055	84.87	595	<.001	4.550	4.766		
Subj. Age Bias	.030	.011	2.71	595	.007	.008	.051	.11	.04
Rel. Quality	.010	.056	.17	595	.865	−.101	.120	.01	.04
Age Level	−.065	.010	−6.60	595	<.001	−.085	−.046	.26	.04
Subj. Age Bias × Rel. Quality	.021	.011	1.90	595	.058	−.001	.044	.08	.04
Subj. Age Bias × Age Level	.000	.001	.73	595	.465	−.001	.002	.03	.04
Age Level × Rel. Quality	−.020	.011	−1.90	595	.058	−.042	.001	.08	.04
Subj. Age Bias × Age Level × Rel. Quality	.000	.001	−.03	595	.974	−.001	.001	.00	.04
Intercept	4.599	.084	54.79	586	<.001	4.434	4.763		
Subj. Age Bias	**.032**	**.013**	**2.41**	**586**	**.016**	**.006**	**.058**	**.10**	**.04**
Rel. Quality	−.040	.063	−.63	586	.529	−.163	.084	.03	.04
Age Level	−.075	.016	−4.68	586	<.001	−.107	−.044	.19	.04
Subj. Age Bias × Rel. Quality	**.023**	**.011**	**2.05**	**586**	**.041**	**.001**	**.045**	**.08**	**.04**
Subj. Age Bias × Age Level	.001	.001	1.01	586	.315	−.001	.002	.04	.04
Age Level × Rel. Quality	−.023	.011	−2.18	586	.030	−.044	−.002	.09	.04
Subj. Age Bias × Age Level × Rel. Quality	.000	.001	.27	586	.789	−.001	.002	.01	.04
BMI	−.019	.009	−2.22	586	.027	−.037	−.002	.09	.04
Smoker	−.006	.097	−.07	586	.948	−.197	.184	.00	.04
Heart Disease	.214	.159	1.35	586	.179	−.098	.527	.06	.04
High BP	.041	.108	.38	586	.705	−.171	.253	.02	.04
Gender	−.018	.098	−.19	586	.852	−.210	.174	.01	.04
Education	−.015	.020	−.77	586	.444	−.054	.024	.03	.04
Subj. Health	.171	.057	2.99	586	.003	.058	.283	.12	.04
Wave 2 Rel. Quality	.047	.052	.89	586	.373	−.056	.150	.04	.04
Rel. Length	.004	.006	.58	586	.564	−.009	.016	.02	.04

Note. $N = 603$. Effect size estimates are in units of r, where $r = \sqrt{t^2/(t^2 + df)}$. The sampling error for r is denoted *SE*r, where $SEr = 1/\sqrt{n - 3}$. The top panel of the table shows results obtained from a model with main effect terms only for subjective age bias, relationship quality, and age level. The middle panel shows results obtained from a model with subjective age bias, relationship quality, age level, and all interaction terms. The bottom panel shows results obtained from a model with the same predictors as the middle panel plus covariates. Effects of interest are shown in bold text. Subj. = Subjective; Rel. = relationship; BMI = body mass index.

up to two out of the four analyses presented below; the remainder ($n = 567$) were included in all analyses. The only difference between these groups was that participants who contributed data to all analyses were younger, had a smaller subjective age bias at Wave 2, and performed better on the memory task.

Results

Operationalization of Subjective Age Bias (SAB)

To compute subjective age bias (SAB; how much younger or older participants felt compared to their chronological age), we subtracted subjective age from chronological age. Positive numbers indicate that participants felt younger than they actually were, whereas negative numbers indicate that participants felt older than they actually were.

One consideration with using difference scores as predictors, such as this operationalization of SAB, is that the difference is often correlated with level. For example, this would be reflected by older adults reporting larger subjective ages biases. For this reason, we followed leading statistical guidelines by including SAB and age level (the average of subjective age and chronological age) as simultaneous predictors in our analyses. Adjusting for level makes the difference score more interpretable, because the model becomes equivalent to a model using subjective age and chronological age as predictors. The rationale for using difference and level as simultaneous predictors is described in detail in other work (Gelman & Stern, 2006; Zee, Cavallo, Flores, Bolger, & Higgins, 2018). For the purposes of this article, using the difference-and-level approach was also theoretically advantageous, because SAB effects could be interpreted in units of years. Given that relatively little work has examined moderators of subjective age bias effects, it seemed useful to separate subjective age bias and age in order to understand where any potential moderating effects might be occurring (i.e., to determine whether interactive effects involving relationship quality were operating on SAB effects, on age level effects, or both). Thus, age level was included as a covariate,[1] and we allowed age level to interact with SAB and relationship quality

[1] We also tested for potential quadratic effects of age level. Although there were some main effects, similar to the linear age level effects, there was no clear pattern of interactions involving quadratic age level.

Table 4
Summary of Effects of Subjective Age Bias at Different Levels of Relationship Quality (Measured at Wave 1)

DV	Level	Value	Estimate	*t*	*p*	Lower	Upper
Memory	Max. Observed	5.00	0.033	2.84	.005	0.010	0.056
Memory	+1 SD	4.96	0.032	2.84	.005	0.010	0.055
Memory	Mean	3.93	0.015	1.75	.080	−0.002	0.032
Memory	−1 *SD*	2.89	−0.003	−0.22	.822	−0.026	0.020
Memory	−2 *SD*	1.85	−0.020	−1.12	.262	−0.055	0.015
Memory	Min. Observed	1.00	−0.034	−1.45	.147	−0.081	0.012
HRV	Max. Observed	5.00	0.057	3.19	.001	0.022	0.092
HRV	+1 *SD*	4.96	0.056	3.19	.001	0.022	0.090
HRV	Mean	3.93	0.032	2.41	.016	0.006	0.058
HRV	−1 *SD*	2.89	0.008	0.44	.658	−0.027	0.043
HRV	−2 *SD*	1.85	−0.016	−0.59	.554	−0.070	0.037
HRV	Min. Observed	1.00	−0.036	−1.00	.320	−0.106	0.035

Note. HRV = Heart rate variability. Estimates for slopes of subjective age bias at varying levels of relationship quality are based on results from the full model (including covariates).

to help ensure that the hypothesized interaction effects were not age-confounded.

We note that there are different approaches to operationalizing subjective age bias. Currently, a popular approach involves using a proportional discrepancy, defined as SAB_{PD} = (chronological age − felt age)/chronological age, such that SAB_{PD} is interpreted as a percentage (e.g., feeling 10% younger than one's chronological age). We used the difference-and-level method described above because it better qualitatively captured colloquial experiences of subjective age bias ("I feel 20 years younger!"). In contrast, it is less common to hear individuals talk about feeling 10% younger, and we were not aware of any evidence that individuals think about their subjective age in terms of percentages. In addition, there is no research to date that suggests individuals consider their felt age relative to their lifetime. In other words, it is unknown whether feeling 10 years younger or older represents the proposed qualitative perceptual difference for a 45- or 65-year-old person as implied by the proportional subjective age score. However, future research is clearly needed to examine individuals' representation and perception of time and age across the life span. For the interested reader, analyses using the proportional discrepancy operationalization are presented in the online supplemental materials (see Tables S2–S5).[2]

Model Specification

We used multiple regression models to test for the hypothesized interactive effects of SAB and relationship quality on memory performance and resting HRV. Because SAB and relationship quality were measured at both Waves 1 and 2, we examined the effects of Wave 1 variables and Wave 2 variables separately to determine whether their effects held over time. All continuous variables were grand-mean centered (using mean values from the full sample) prior to analysis; coding of binary predictor variables is described above under Covariates. In addition to the exclusions noted above, we discovered three observations for Wave 1 subjective age bias that were unusually large in the context of the analytic sample (Wave 1 SAB >40). To ensure that these extreme observations were not unduly influential, they were removed prior to analysis. Note that results did not change appreciably when the observations were included versus not included in the analyses.[3]

Results for effects using Wave 1 SAB and relationship quality as our focal predictors are presented in Tables 2–4, and drew on 643 and 603 participants for effects on memory performance and HRV, respectively. Results for effects using Wave 2 focal predictors are presented in Tables 5–7, and drew on 639 and 601 participants for memory performance and HRV, respectively. As noted above, the majority of participants in the analytic sample were common to all four analyses (n = 567).

For each outcome at each wave, we fit three models. First, we fit a model in which main effects of SAB, age level, and relationship quality were entered as simultaneous predictors (top panel of Tables 2, 3, 5, and 6). Second, we fit a model in which we added all possible interaction terms among the variables used in the first model: SAB × Age Level; SAB × Relationship Quality; Age Level × Relationship Quality; and SAB × Age Level × Relationship Quality (middle panel).

Third, we then fit a model that included all main effect and interaction terms, plus the covariates described previously (full model). Given that relationship quality can have both concurrent and longitudinal effects (Robles et al., 2014), this model also controlled for relationship quality measured at the other wave. This was done in order to gauge whether the interactive effects of SAB and relationship quality held over and above potential effects of relationship quality at the other timepoint. Results reported in the text below were drawn from this model (bottom panel). Next, we calculated simple effects of SAB at varying levels of relationship quality using estimates from the full models (see Tables 4 and 7).

[2] As these Supplemental Tables show, the main effects for SAB_{PD} were negative, which is the opposite direction of SAB effects documented in the literature. Therefore, we were concerned that effects of feeling younger could not be separated from the effects of chronological age using this operationalization.

[3] Although the size of the effect remained largely the same, with the inclusion of these observations the Wave 1 SAB by relationship quality interaction predicting HRV became marginally significant. For details, see the online supplemental materials.

Table 5
Summary of Results for Performance on an Episodic Memory Task Showing Moderation of Subjective Age Bias by Relationship Quality (Measured at Wave 2), With Unstandardized Coefficients

Coefficient	Estimate	*SE*	*t*	*df*	*p*	Lower	Upper	Effect size	*SE*r
Intercept	.088	.033	2.69	635	.007	.024	.152		
Subj. Age Bias	.035	.006	6.08	635	<.001	.024	.047	.23	.04
Rel. Quality	−.031	.032	−.95	635	.343	−.094	.033	.04	.04
Age Level	−.062	.006	−10.08	635	<.001	−.074	−.050	.37	.04
Intercept	.086	.037	2.32	631	.021	.013	.159		
Subj. Age Bias	.035	.006	5.90	631	<.001	.023	.046	.23	.04
Rel. Quality	−.038	.037	−1.03	631	.305	−.111	.035	.04	.04
Age Level	−.061	.006	−9.71	631	<.001	−.073	−.048	.36	.04
Subj. Age Bias × Rel. Quality	.012	.006	1.95	631	.052	.000	.024	.08	.04
Subj. Age Bias × Age Level	.000	.000	.81	631	.419	.000	.001	.03	.04
Age Level × Rel. Quality	−.013	.007	−1.87	631	.062	−.026	.001	.07	.04
Subj. Age Bias × Age Level × Rel. Quality	.000	.000	−.59	631	.557	−.001	.000	.02	.04
Intercept	.085	.054	1.59	622	.113	−.020	.191		
Subj. Age Bias	**.016**	**.007**	**2.20**	**622**	**.028**	**.002**	**.029**	**.09**	**.04**
Rel. Quality	−.014	.040	−.35	622	.728	−.093	.065	.01	.04
Age Level	−.035	.009	−3.70	622	<.001	−.053	−.016	.15	.04
Subj. Age Bias × Rel. Quality	**.012**	**.006**	**2.12**	**622**	**.034**	**.001**	**.023**	**.08**	**.04**
Subj. Age Bias × Age Level	.000	.000	1.16	622	.248	.000	.001	.05	.04
Age Level × Rel. Quality	−.011	.006	−1.63	622	.103	−.023	.002	.07	.04
Subj. Age Bias × Age Level × Rel. Quality	.000	.000	−.46	622	.648	−.001	.000	.02	.04
BMI	−.004	.006	−.74	622	.461	−.015	.007	.03	.04
Smoker	−.003	.063	−.04	622	.965	−.127	.121	.00	.04
Heart Disease	−.091	.098	−.93	622	.353	−.285	.102	.04	.04
High BP	−.085	.070	−1.22	622	.222	−.222	.052	.05	.04
Gender	−.548	.064	−8.62	622	<.001	−.673	−.424	.33	.04
Education	.055	.013	4.35	622	<.001	.030	.080	.17	.04
Subj. Health	.085	.037	2.30	622	.022	.012	.157	.09	.04
Wave 1 Rel. Quality	−.016	.037	−.42	622	.677	−.089	.058	.02	.04
Rel. Length	−.005	.003	−1.52	622	.129	−.012	.002	.06	.04

Note. $N = 639$. Effect size estimates are in units of r, where $r = \sqrt{t^2/(t^2 + df)}$. The sampling error for r is denoted SEr, where $SE\text{r} = 1/\sqrt{n-3}$. The top panel of the table shows results obtained from a model with main effect terms only for subjective age bias, relationship quality, and age level. The middle panel shows results obtained from a model with subjective age bias, relationship quality, age level, and all interaction terms. The bottom panel shows results obtained from a model with the same predictors as the middle panel plus covariates. Effects of interest are shown in bold text. Subj. = Subjective; Rel. = relationship; BMI = body mass index.

Effects at 1 *SD* above and below the mean on relationship quality are also reported in the main text.

Effects of Wave 1 SAB and Relationship Quality on Memory Performance and HRV a Decade Later

First, we tested for effects of SAB and relationship quality measured during Wave 1. Memory performance and HRV measures were, on average, obtained approximately 9.20 (range = 8–11) and 11.20 (range = 9–14) years after Wave 1, respectively.

Memory performance. Consistent with previous findings, SAB at Wave 1 predicted marginally better memory performance approximately one decade later (Stephan et al., 2014), $b = 0.015$, $t(626) = 1.75$, $p = .080$, 95% CI [−0.002, 0.032]. As predicted, this effect was qualified by an interaction of SAB and relationship quality, $b = 0.017$, $t(626) = 2.24$, $p = .025$, 95% CI [0.002, 0.032]. Younger SAB was associated with better memory performance among individuals in higher-quality relationships (+1 *SD*), $b = 0.032$, $t = 2.84$, $p = .005$, 95% CI [0.010, 0.055]. This association was not found for those in lower-quality relationships (−1 *SD*), $b = -0.003$, $t = -0.22$, $p = .822$, 95% CI [−0.026, 0.020]. See Figure 1 and Table 2.

Heart rate variability. Consistent with work showing health benefits of a younger subjective age (Stephan et al., 2015; Westerhof et al., 2014), SAB at Wave 1 positively predicted later HRV, $b = 0.032$, $t(586) = 2.41$, $p = .016$, 95% CI [0.006, 0.058]. Moreover, there was an interaction of SAB and relationship quality predicting later HRV,[4] $b = 0.023$, $t(586) = 2.05$, $p = .041$, 95% CI [0.001, 0.045]. Younger SAB was positively associated with later HRV among individuals in higher-quality relationships, $b = 0.056$, $t = 3.19$, $p = .001$, 95% CI [0.022, 0.090]. This association was not found among individuals in lower-quality relationships, $b = 0.008$, $t = 0.44$, $p = .658$, 95% CI [−0.027, 0.043]. See Figure 2 and Table 3.

Moreover, for both outcomes, follow-up analyses showed no meaningful age differential effects, and the results were stable above and beyond the inclusion of other individual difference variables (i.e., sense of control, agreeableness, conscientiousness, and psychological well-being).

[4] Note that this effect appeared to be sensitive to the inclusion of Wave 2 relationship quality as a control variable. For details, see the online supplemental materials.

Table 6
Summary of Results for Heart Rate Variability Showing Moderation of Subjective Age Bias by Relationship Quality (Measured at Wave 2), With Unstandardized Coefficients

Coefficient	Estimate	*SE*	*t*	*df*	*p*	Lower	Upper	Effect size	*SE*r
Intercept	4.657	.047	98.42	597	<.001	4.564	4.750		
Subj. Age Bias	.036	.008	4.33	597	<.001	.020	.053	.17	.04
Rel. Quality	.059	.047	1.26	597	.207	−.033	.150	.05	.04
Age Level	−.073	.009	−8.02	597	<.001	−.091	−.055	.31	.04
Intercept	4.638	.054	86.03	593	<.001	4.532	4.743		
Subj. Age Bias	.037	.009	4.32	593	<.001	.020	.053	.17	.04
Rel. Quality	.042	.055	.77	593	.442	−.065	.150	.03	.04
Age Level	−.071	.009	−7.63	593	<.001	−.089	−.052	.30	.04
Subj. Age Bias × Rel. Quality	.025	.009	2.81	593	.005	.008	.043	.11	.04
Subj. Age Bias × Age Level	.001	.000	1.18	593	.238	.000	.002	.05	.04
Age Level × Rel. Quality	−.014	.010	−1.37	593	.172	−.034	.006	.06	.04
Subj. Age Bias × Age Level × Rel. Quality	.000	.000	.03	593	.973	−.001	.001	.00	.04
Intercept	4.552	.084	54.14	584	<.001	4.387	4.717		
Subj. Age Bias	**.043**	**.011**	**4.02**	**584**	**<.001**	**.022**	**.064**	**.16**	**.04**
Rel. Quality	.023	.062	.36	584	.715	−.100	.145	.02	.04
Age Level	−.088	.014	−6.15	584	<.001	−.116	−.060	.25	.04
Subj. Age Bias × Rel. Quality	**.027**	**.009**	**2.98**	**584**	**.003**	**.009**	**.044**	**.12**	**.04**
Subj. Age Bias × Age Level	.001	.000	1.99	584	.047	.000	.002	.08	.04
Age Level × Rel. Quality	−.016	.010	−1.61	584	.108	−.036	.004	.07	.04
Subj. Age Bias × Age Level × Rel. Quality	.000	.000	.18	584	.855	−.001	.001	.01	.04
BMI	−.019	.009	−2.18	584	.030	−.036	−.002	.09	.04
Smoker	−.012	.096	−.13	584	.897	−.202	.177	.01	.04
Heart Disease	.168	.159	1.06	584	.290	−.144	.480	.04	.04
High BP	.054	.108	.50	584	.617	−.158	.267	.02	.04
Gender	−.046	.098	−.47	584	.635	−.238	.145	.02	.04
Education	−.014	.020	−.69	584	.493	−.052	.025	.03	.04
Subj. Health	.182	.058	3.13	584	.002	.068	.296	.13	.04
Wave 1 Rel. Quality	−.004	.056	−.07	584	.945	−.114	.106	.00	.04
Rel. Length	.009	.005	1.72	584	.086	−.001	.019	.07	.04

Note. $N = 601$. Effect size estimates are in units of r, where $r = \sqrt{t^2/(t^2 + df)}$. The sampling error for r is denoted *SE*r, where $SEr = 1/\sqrt{n - 3}$. The top panel of the table shows results obtained from a model with main effect terms only for subjective age bias, relationship quality, and age level. The middle panel shows results obtained from a model with subjective age bias, relationship quality, age level, and all interaction terms. The bottom panel shows results obtained from a model with the same predictors as the middle panel plus covariates. Effects of interest are shown in bold text. Subj. = Subjective; Rel. = relationship; BMI = body mass index.

Effects of Wave 2 SAB and Relationship Quality on Memory Performance and HRV Months Later

Next, we examined effects of SAB and relationship quality measured during Wave 2. We did so because subjective age effects tend to be stronger when measured proximally to outcome variables (Westerhof et al., 2014) and because we were interested in whether the proposed interaction effects would hold over time. On average, memory performance was assessed approximately 4.80 months (range = 0–23) after Wave 2, and HRV was measured approximately 2.20 years (range = 0–5) after Wave 2. Thus, Wave 2 results can also be interpreted as shorter-term longitudinal effects for the average participant.[5]

Memory performance. Once again, there was a main effect of SAB on memory performance, $b = 0.016$, $t(622) = 2.20$, $p = .028$, 95% CI [0.002, 0.029]. This effect was qualified by an interaction of SAB and relationship quality, $b = 0.012$, $t(622) = 2.12$, $p = .034$, 95% CI [0.001, 0.023]. A younger SAB was associated with better memory performance among individuals in higher-quality relationships, $b = 0.028$, $t = 3.04$, $p = .002$, 95% CI [0.010, 0.045]. This association was not found for lower quality relationships, $b = 0.003$, $t = 0.39$, $p = .699$, 95% CI [−0.014, 0.021]. See Figure 3 and Table 5.

Heart rate variability. There was a main effect of SAB predicting higher HRV two years later, $b = 0.043$, $t(584) = 4.02$, $p < .001$, 95% CI [0.022, 0.064]. However, as predicted, this effect depended on relationship quality, $b = 0.027$, $t(584) = 2.98$, $p = .003$, 95% CI [0.009, 0.044]. A younger SAB was associated with higher HRV among individuals in higher-quality relationships, $b = 0.070$, $t = 5.11$, $p < .001$, 95% CI [0.043, 0.097]. This association was not found for individuals in lower-quality relationships, $b = 0.016$, $t = 1.13$, $p = .261$, 95% CI [−0.012, 0.044]. See Figure 4 and Table 6.

Again, for both outcomes, follow-up analyses showed no meaningful age differential effects, and results held above and beyond the inclusion of other individual difference variables (i.e., sense of control, agreeableness, conscientiousness, and psychological well-being).

Results Across Waves

Results generally suggested that SAB and relationship quality, measured both at Wave 1 and Wave 2, interacted to predict

[5] Results for both outcomes remained essentially the same when controlling for time elapsed since Wave 2.

Table 7
Summary of Effects of Subjective Age Bias at Different Levels of Relationship Quality (Measured at Wave 2)

DV	Level	Value	Estimate	*t*	*p*	Lower	Upper
Memory	Max. Observed	5.00	.027	3.03	.003	.010	.045
Memory	+1 *SD*	5.05	.028	3.04	.002	.010	.045
Memory	Mean	4.04	.016	2.21	.027	.002	.029
Memory	−1 *SD*	3.02	.003	.39	.699	−.014	.021
Memory	−2 *SD*	2.01	−.009	−.64	.520	−.035	.018
Memory	Min. Observed	1.00	−.020	−1.12	.264	−.056	.015
HRV	Max. Observed	5.00	.069	5.12	<.001	.042	.095
HRV	+1 *SD*	5.05	.070	5.11	<.001	.043	.097
HRV	Mean	4.04	.043	4.03	<.001	.022	.064
HRV	−1 *SD*	3.02	.016	1.13	.261	−.012	.044
HRV	−2 *SD*	2.01	−.011	−.50	.615	−.053	.031
HRV	Min. Observed	1.00	−.037	−1.27	.206	−.095	.021

Note. HRV = Heart rate variability. Estimates for slopes of subjective age bias at varying levels of relationship quality are based on results from the full model (including covariates).

memory performance and resting HRV. Across outcomes and timepoints, these effects were not further moderated by age level. This suggests that the degree to which the strength of SAB effects depended on relationship quality was similar across the age range examined in this investigation; for specific tests, see Tables 2, 3, 5, and 6.

In addition, the magnitude of the interaction effects for each outcome remained stable across waves. In follow-up analyses, no differences between the SAB by relationship quality interaction effects at Waves 1 and 2 were found; difference of interaction effects at Waves 1 and 2 predicting memory performance: b = 0.005, t = 0.53, p = .595, 95% CI [−0.013, 0.023]; difference of

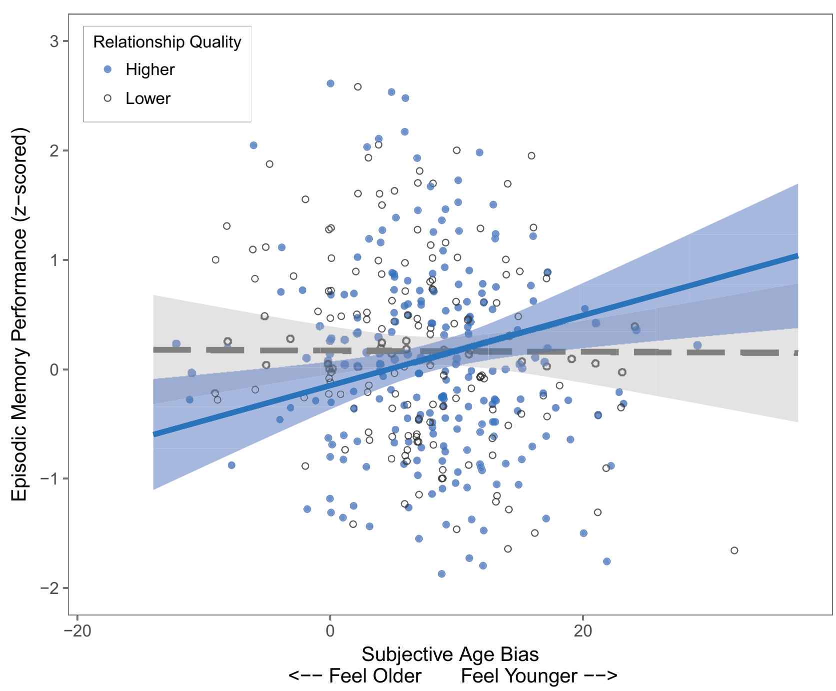

Figure 1. Interaction of subjective age bias and relationship quality (Wave 1) predicts memory performance. The solid line shows predicted values at +1 *SD* on relationship quality, and the dashed line shows predicted values at −1 *SD* on relationship quality. Dots are raw data points (jittered), and shaded bands are 95% confidence intervals. Solid data points show values falling more than +.5 *SD* above the mean, and open data points show values falling more than −.5 *SD* below the mean. Data points falling within .5 *SD* of the mean are not displayed for clarity of presentation but are included in the analysis. The interaction effect depicted was drawn from the full model, which included covariates. See the online article for the color version of this figure.

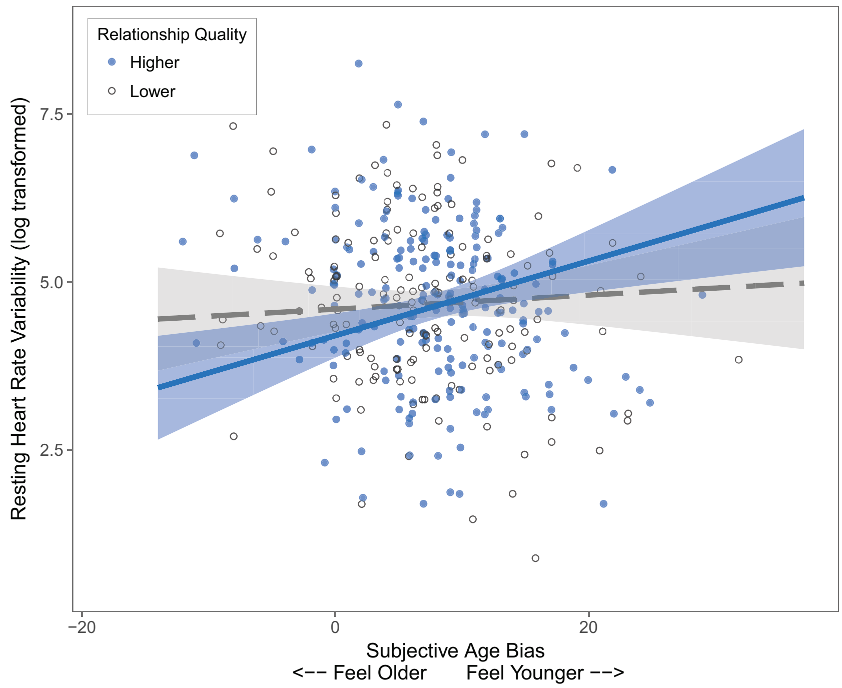

Figure 2. Interaction of subjective age bias and relationship quality (Wave 1) predicts resting heart rate variability (log transformed). The solid line shows predicted values at +1 *SD* on relationship quality, and the dashed line shows predicted values at −1 *SD* on relationship quality. Dots are raw data points (jittered), and shaded bands are 95% confidence intervals. Solid data points show values falling more than +.5 *SD* above the mean, and open data points show values falling more than −.5 *SD* below the mean. Data points falling within .5 *SD* of the mean are not displayed for clarity of presentation but are included in the analysis. The interaction effect depicted was drawn from the full model, which included covariates. See the online article for the color version of this figure.

interaction effects at Waves 1 and 2 predicting HRV: $b = -0.003$, $t = -0.23$, $p = .815$, 95% CI [−0.032, 0.025].

Discussion

This article investigated the hypothesis that marital relationship quality moderates the effects of a younger SAB on indicators of cognitive and cardiovascular health. Consistent with these predictions, results revealed interactive effects showing that the beneficial associations of a younger SAB with memory performance and with resting heart rate variability (HRV) were stronger among individuals in higher-quality relationships. Evidence for these effects was obtained using a multimethod approach including measures of SAB and relationship quality obtained both decades and months before the assessment of cognitive and cardiovascular health. Moreover, follow-up analyses indicated that these interactive effects remained largely the same when controlling for other individual difference variables (i.e., sense of control, agreeableness, conscientiousness, and psychological well-being), and did not differ by age level across the sample.

Implications for Subjective Age Research

These findings contribute to work on subjective age in several ways. This is one of the first investigations highlighting the interplay between subjective age bias and relationship factors. An incidental finding of the current research was that we demonstrated a link between younger SAB and higher resting HRV. To our knowledge, no other work has linked SAB to this marker of cardiovascular health. This is important given evidence that lower HRV is prospectively associated with heart disease and incidence of cardiac events (Schroeder et al., 2003; Tsuji et al., 1996). Moreover, this effect was further modulated by relationship quality such that SAB was more strongly associated with HRV for people in higher quality relationships.

Implications for Relationships Research

Although links between relationship quality and health are well known, recent work has called for a better understanding of moderators of this association (Robles et al., 2014; Slatcher & Selcuk, 2017). This article addresses this call in a novel way by examining subjective age bias, which has rarely been considered in the close relationships literature. In addition, while many studies have examined how relationship processes and social support influence physical health markers (Uchino, 2009; Uchino, Kiecolt-Glaser, & Cacioppo, 1992), less work has considered how relationships affect cognitive health, such as memory.

This study also illuminated an unexpected implication of good quality relationships. As shown in Figures 1–4, at lower levels of SAB (feeling older), individuals with a similar level of older SAB would be predicted to experience worse health outcomes if they

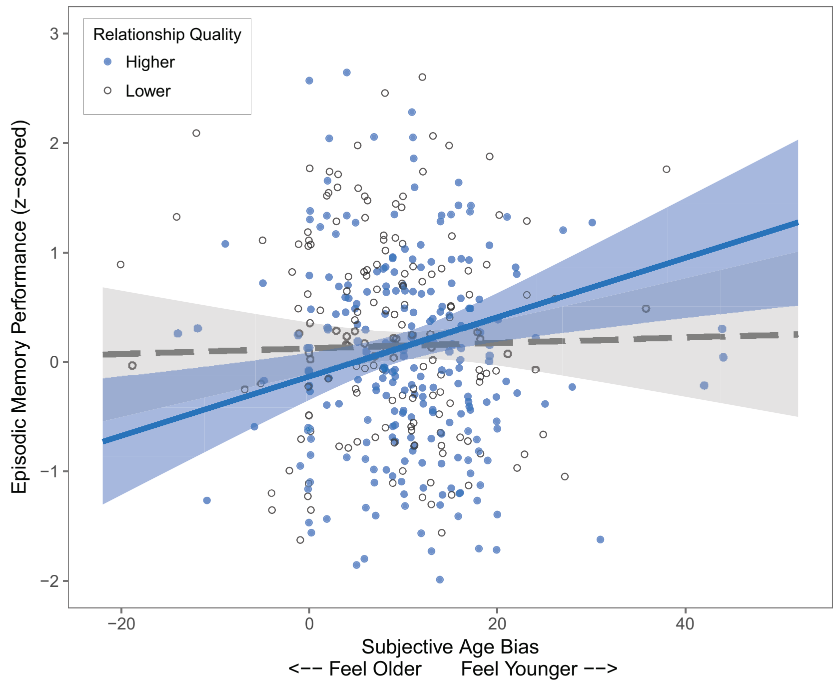

Figure 3. Interaction of subjective age bias and relationship quality (Wave 2) predicts episodic memory performance. The solid line shows predicted values at +1 *SD* on relationship quality, and the dashed line shows predicted values at −1 *SD* on relationship quality. Dots are raw data points (jittered), and shaded bands are 95% confidence intervals. Solid data points show values falling more than +.5 *SD* above the mean, and open data points show values falling more than −.5 *SD* below the mean. Data points falling within .5 *SD* of the mean are not displayed for clarity of presentation but are included in the analysis. The interaction effect depicted was drawn from the full model, which included covariates. See the online article for the color version of this figure.

were in a higher-quality relationship versus lower-quality relationship. Work on self-verification could explain this finding: Individuals are motivated to have close others validate their self-view, and some individuals desire self-verification from their partner even for negative aspects of the self (e.g., Swann, Pelham, & Krull, 1989). This suggests that individuals in higher-quality relationships might nevertheless experience health costs if they have an older SAB. If partners reinforce individuals' perceptions of the self as "older," then those individuals might be less likely to engage in health-protective activities typically seen as incongruent with older age (e.g., exercise). In this situation, adults might engage in negative age-based self-stereotyping due to the elevated self-relevance of negative age stereotypes (Weiss & Kornadt, 2018). However, we note that this feature of the interaction effect was not one that we had anticipated prior to conducting these analyses. Future research should aim to investigate it further.

Limitations and Future Directions

Although this article offers an important initial step, one limitation was that it was not possible to test specific mechanisms driving this effect. Partner affirmation for one's younger subjective age could be a critical process through which these interactive effects influence health. In addition, individuals' relationship quality and satisfaction with their interpersonal interactions can fluctuate day to day (Mejía & Hooker, 2013, 2015). Daily changes in relationship quality may have important implications for the effects of subjective age bias over time. Future research could consider how daily changes in relationship quality affect individuals' engagement in behaviors compatible with their subjective age. Thus, additional research using more targeted measures and methods to examine mechanisms will be an important future direction.

Another limitation is that these results only speak to the role of higher quality marital relationships. This was a logical starting point due to established links between marital quality and health (Robles et al., 2014). Older adults often have close relationships with other individuals, such as adult children (Doherty & Feeney, 2004), which may be important for their well-being (Mejía & Hooker, 2015). However, less is known about how the quality of nonmarital relationships is linked to health. Testing for these effects in other relationship contexts could be a fruitful avenue for further research.

Furthermore, it is important to note that the interactive effects obtained were small. Effects might be stronger using a more targeted measure of relationship quality (e.g., a measure specifically capturing the frequency or quality of partner validation for ideal self-views), as opposed to the general measure used in the present investigation. However, as demonstrated in a recent meta-

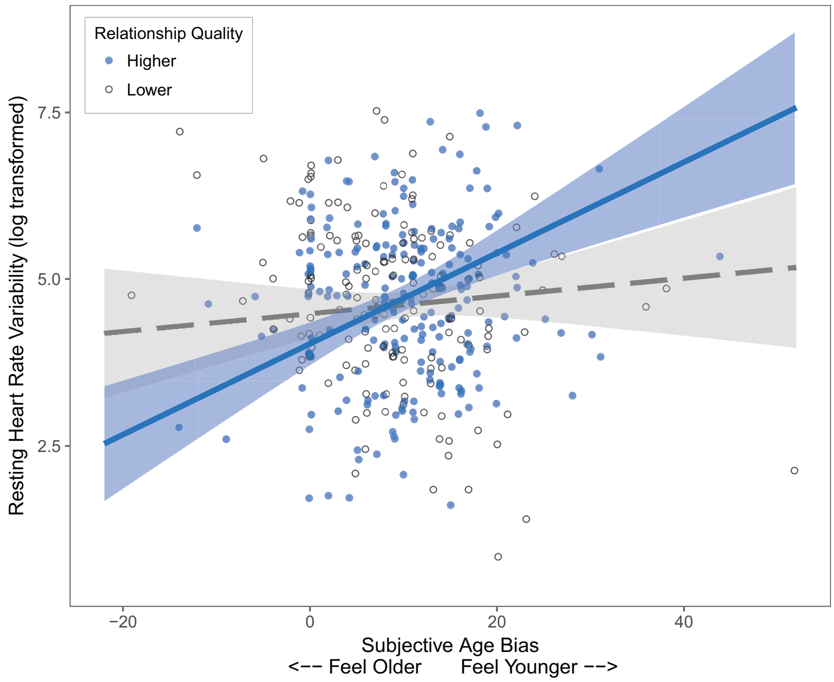

Figure 4. Interaction of subjective age bias and relationship quality (Wave 2) predicts resting heart rate variability (log transformed). The solid line shows predicted values at +1 *SD* on relationship quality, and the dashed line shows predicted values at −1 *SD* on relationship quality. Dots are raw data points (jittered), and shaded bands are 95% confidence intervals. Solid data points show values falling more than +.5 SD above the mean, and open data points show values falling more than −.5 *SD* below the mean. Data points falling within .5 *SD* of the mean are not displayed for clarity of presentation but are included in the analysis. The interaction effect depicted was drawn from the full model, which included covariates. See the online article for the color version of this figure.

analysis (Westerhof et al., 2014), subjective age effects tend to be small, and effect sizes tend to be weaker for longitudinal effects, which was a feature of the analyses presented here. Also of note is our use of objective markers of health, and it is possible that stronger associations might be found for self-reported indicators of health. Similarly, effect sizes for relationship quality's links to health also tend to be small, with *r*s ranging from .07 to .21 (Robles et al., 2014). Nevertheless, for both subjective age and relationship quality main effects, the literature suggests that their contributions to physical health are similar in size to other important variables (e.g., physical activity, diet; Robles et al., 2014; Stephan et al., 2014). In addition, in this investigation the simple effects of subjective age bias at higher levels of relationship quality were consistent and precisely estimated. Therefore, although we suggest caution in interpreting the magnitude of the interactive effects of subjective age and relationship quality, this research may nevertheless offer important insight into the conditions under which subjective age bias may have stronger versus weaker links to objective health markers. Future research should aim to replicate these interaction effects in other samples.

In addition, there is the possibility of positive selection bias, as our hypotheses were tested in a longitudinal sample of individuals who provided data at the necessary timepoints and were married or in a marriage-like relationship. This could limit the generalizability of the findings. More work is needed to examine whether similar benefits of high-quality relationships on subjective age bias effects hold in more representative samples and in other populations.

Conclusions

This research is among the first to reveal conditions that may strengthen the benefits of a younger subjective age bias. Results suggest that individuals' interpersonal relationships may play a key role in shaping the effects of subjective age on health and invite greater consideration of how intrapersonal and interpersonal resources might work together to influence well-being across adulthood.

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