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Original Research Report

Examination of Associations Among Three Distinct Subjective Aging Constructs and Their Relevance for Predicting Developmental Correlates

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Abstract

Objectives: This study examined (a) the empirical associations among three subjective aging (SA) constructs: felt age, attitudes toward own aging (ATOA), and awareness of age-related change (AARC); (b) the moderating role of chronological age in these associations; and (c) the predictive relevance of the SA constructs with regard to two developmental correlates: functional health and satisfaction with life.

Method: Participants were 819 adults aged 40–98 years from the United States and Germany. Parallel multiple mediation, moderated mediation, and hierarchical regression analyses were used.

Results: As hypothesized, AARC mediated the association between the global measures of SA (felt age and ATOA) and the developmental correlates. Specifically, more negative global subjective aging predicted more AARC losses, which predicted poorer health and well-being. Furthermore, this mediation pathway was moderated by chronological age, such that, with increasing age, greater AARC was more strongly related to poorer functional health (but not well-being). The multidimensional measure, AARC, accounted for a significant amount of the variance in the developmental correlates over and above the unidimensional SA constructs. A consistent pattern emerged supporting the role of domain specificity and valence.

Discussion: These findings support the need for conceptualizing SA across different behavioral domains and for distinguishing between positive and negative SA.

Keywords: Attitudes toward aging—Developmental correlates—Subjective aging

Recent research has focused a great deal on individuals' perceptions of their own aging, often referred to as *subjective aging* (SA; Diehl et al., 2014). SA is an overarching term, referring to many different conceptualizations of the ways in which individuals experience the aging process. Although extensive evidence documents the association between measures of SA and important outcomes such as health and well-being (Westerhof et al., 2014), the empirical associations *among* various SA constructs are currently not well understood.

Given the variety of ways in which SA has been conceptualized over the past several decades, the objective of the present study was to explore the empirical inter-relations among three constructs that differ in complexity of measurement (Diehl et al., 2014): felt age, attitudes toward own aging (ATOA), and a new construct, awareness of age-related change (AARC). Using data from a combined sample of U.S. and German adults, we examined these constructs as they relate to one another and as they relate to two key developmental correlates: functional health and

life satisfaction. Both physical and psychological correlates were of interest because they are common outcome variables in subjective aging research (Mock & Eibach, 2011; Westerhof et al., 2014) and represent key indicators of successful aging. Moreover, the three SA constructs may show differential associations with these developmental correlates, yet this question has not been addressed in the literature.

Rationale for the Selection of the Three Measures of Subjective Aging

Traditional approaches to conceptualizing SA have relied primarily on measures that are quite simple in their approach, yet show robust associations with important outcomes in later life. Felt age draws upon the notion that an individual's perceived age may deviate from his or her chronological age as a consequence of "anchoring and adjusting one's age" (Montepare, 2009, p. 43) in response to situational age-relevant experiences. The lack of explicit reference to individuals' specific personal aging experiences might be regarded as a limitation of felt age ratings (Diehl et al., 2014). Thus felt age captures SA at a rather general level but is nonetheless a powerful predictor of developmental outcomes, including health and well-being (Barrett, 2003; Hubley & Russell, 2009; Westerhof & Barrett, 2005). (Although Kastenbaum and colleagues (1972) proposed several dimensions of subjective age (e.g., look age, feel age, do age, and interest age), felt age is the most commonly used stand-alone measure in psychological aging research and therefore is not actually treated as the multidimensional construct it was first conceptualized to be; Kastenbaum, Derbin, Sabatini, & Artt, 1972).

The ATOA scale (Lawton, 1975) uses a global evaluation of a person's aging process and can be regarded as reflecting a general attitude with which an individual approaches his or her own aging. In general, attitudes are composed of affective, cognitive, and behavioral components (cf., Eagly & Chaiken, 1998; Fiske & Taylor, 1991). The way the items of the ATOA scale is phrased (e.g., "Do things keep getting worse as you get older?") suggests that ATOA captures mainly affective and cognitive responses to a person's own aging. Like felt age, ATOA is associated with many developmental outcomes, including health and well-being (Bryant et al., 2012; Levy, 2003; Moser, Spagnoli, & Santos-Eggimann, 2011).

The AARC construct (Diehl & Wahl, 2010) is presented as a third variant of SA assessment because of its emphasis on multidimensionality and the valence of adults' reported experiences. Although multidimensional approaches of SA have been suggested for some time (e.g., Steverink, Westerhof, Bode, & Dittmann-Kohli, 2001), recent theoretical advances (Diehl, Wahl, Brothers, & Miche, 2015; Diehl et al., 2014) allow for a more elaborated conceptualization of SA. Based on this background, AARC captures a person's experienced age-related change in terms of gains and losses in a total of five behavioral domains, such as physical health or cognitive functioning (Diehl & Wahl, 2010). According to the definition provided by Diehl and Wahl (2010), AARC is comprised of "all those experiences that make a person aware that his or her behavior, level of performance, or ways of experiencing his or her life have changed as a consequence of having grown older (i.e., increased chronological age)" (p. 340). The authors assume that as individuals age AARC becomes part of their self-knowledge incorporating both content-related and evaluative information about subjectively experienced age-related changes. Therefore, in contrast to felt age and ATOA, AARC relies on actual behavioral experiences, self-reflection, and conscious awareness, which require individuals to recognize or evaluate specific experiences of age-related change. AARC thus is viewed as being rooted in adults' every-day age-related behaviors and experiences (Miche et al., 2014) and is considered a behavior-specific measure of SA.

Empirical Associations among the SA Constructs

Although the three SA constructs have been shown to be associated with developmental correlates, the extent to which the different SA constructs may interact with one another to influence developmental outcomes has not yet been examined. One way of understanding how various SA constructs are related to one another is to consider the extent to which they rely on global versus behavior-specific evaluations. Thus, based on their conceptual distinctions, the SA constructs in this study can be ordered on a continuum of rating specificity, such that felt age and ATOA are at the "global" end of the continuum, whereas AARC is at the "behavior-specific" end (Diehl et al., 2014).

We argue based on theoretical reasoning that negative global SA ratings operate as a cognitive schema (Hummert, 2011) priming individuals to expect and notice primarily negative age-related changes (e.g., AARC losses), thereby impeding behaviors that promote physical and psychological well-being. Conversely, positive global SA prime individuals to experience more positive age-related changes (e.g., AARC gains) and therefore motivate behaviors that promote physical and psychological well-being (Diehl & Wahl, 2010). Such a pathway is consistent with stereotype embodiment theory, which posits that SA exerts its influence on health and well-being through a series of psychological, behavioral, and physiological pathways (Levy, 2009). However, pathways by which behavior-specific SA mediates the effects of global SA on health and well-being have not yet been empirically tested.

Furthermore, it seems reasonable to assume that such pathways may function differently depending on an individual's age. With age, individuals become increasingly heterogeneous as a result of varying life experiences and differential developmental trajectories (Löckenhoff et al., 2009). Furthermore, subjective aging experiences occur throughout the adult life span, but very likely take

on different meaning at different life stages (Barrett & Montepare, 2015). For instance, perceptions of growing older in one's 50s may involve fairly benign physical changes such as graying hair or wrinkles. In contrast, the experience of growing older in one's 80s or 90s may involve more serious losses in physical health, social relationships, and functional independence (Nilsson, Sarvimäki, & Ekman, 2000). Therefore, the associations among measures of global SA, specific SA, and developmental correlates are likely moderated by chronological age, but this connection has not yet been studied empirically.

Differential Associations of SA Constructs With Health and Well-Being

Because of their differing measurement structures with regard to multidimensionality and valence, the three SA measures are expected to be differentially related to health and well-being. The role of multidimensionality is important for understanding the associations between SA and developmental correlates because domain-specific effects have been found in experimental and longitudinal research with regard to age stereotypes (Levy & Leifheit-Limson, 2009; Wurm, Warner, Ziegelmann, Wolff, & Schüz, 2013). For instance, in an experimental task, participants exposed to negative age stereotype words experienced the strongest effects on performance for behaviors in a corresponding domain. Specifically, exposure to words such as *feeble* and *shaky* exerted a stronger negative effect on a domain-similar balance task than on a cognitive task (Levy & Leifheit-Limson, 2009). In a similar vein, Kornadt and Rothermund (2012) showed that the integration of age stereotypes into adults' self-views was dependent upon life domain and, thus, highlighted the importance of considering domain-specific age stereotypes. However, domain specificity for SA constructs other than age stereotypes has not yet been systematically evaluated.

The valence of aging experiences is also an important measurement characteristic to take into account when evaluating the associations between SA and health and well-being. Although traditional SA constructs treat positive and negative attitudes toward aging as two ends of the same continuum, newer SA constructs acknowledge positive and negative experiences as being mostly independent of one another. AARC considers both age-related gains and losses across all five behavioral domains, positioning valence as a superordinate dimension of domain-specific SA (Wahl, Konieczny, & Diehl, 2013). The distinction of valence is important because negative SA may have a stronger detrimental and more pervasive effect on adults' behavior than the potentially protective effects of positive SA. For example, a meta-analysis found that priming negative age stereotypes exerted almost three times as large of an effect on behavioral outcomes, such as memory and motor tasks, compared with priming positive age stereotypes (Meisner, 2012).

Research Questions and Expectations

Given the variation in approaches to assessing SA, this study had three objectives: (a) to investigate empirical relationships among the SA measures and developmental correlates using mediation analyses; (b) to examine the extent to which age has a moderating effect on these mediation pathways; and (c) to examine the predictive relevance of three SA measures with regard to functional health and satisfaction with life, while evaluating the role of multidimensionality and valence. Regarding the first question, we expected that the measure of AARC would mediate the association between the global SA measures (i.e., felt age, ATOA) and the developmental correlates because it draws on specific behavioral experiences. Regarding the second question, we expected that the association between SA and the developmental correlates would be stronger for older individuals compared with younger individuals. Finally, regarding the third research question, compared with the unidimensional measures, we expected that the multidimensional measure would account for a significantly greater portion of variance in both developmental correlates after controlling for a number of covariates. We also expected a domain-specific effect such that a match between the respective SA dimension (e.g., SA in the physical functioning domain) and developmental correlate (e.g., functional health) would result in a relatively stronger association compared with non-matching dimensions. Further, we expected that the associations between SA and the developmental correlates would be relatively stronger for negative SA compared with positive SA.

Method

Participants and Procedures

The sample was comprised of 819 community-residing adults aged 40–98 years (M = 64.13 years, SD = 12.85 years) from the United States and Germany (Table 1). More than half of participants were women (60.0%), 62.1% were married, and 49.2% were retired. Participants reported above-average education (United States: M = 16.80 years, SD = 2.67 years; Germany: M = 11.53 years, SD = 1.96 years) and income (United States: median gross annual income $70,000–$79,999; Germany: median monthly net income: €2,500–€2,999) and rated their health as very good (M = 5.05, SD = .89, with 6 = Excellent). The sample was analyzed in the aggregate for the present study. Although statistically significant mean differences were found between the two samples with regard to several of the key variables of interest, the differences were small in terms of practical significance (Cohen's d range: .12–.29), reflecting small effect sizes (Cohen, 1988).

Participants were recruited by posting study announcements in public locations and by word of mouth. They completed a self-report questionnaire packet, which took

Table 1. Descriptive Statistics of Demographic Variables and Key Constructs

	U.S. sample	German sample	Total sample
	n = 396	*n* = 423	*N* = 819
	M (*SD*) or %	*M* (*SD*) or %	*M* (*SD*) or %
Age (year)	65.45 (13.75)	62.89 (11.83)	64.13 (12.85)
Gender			
Women	55.3%	64.3%	60.0%
Marital status			
Married	62.9%	61.3%	62.1%
Education			
Low	22.2%	18.0%	20.0%
Medium	44.2%	34.5%	39.2%
High	33.6%	47.5%	40.8%
Employment status			
Retired	52.0%	46.5%	49.2%
Self-rated health possible range: 1 (*very poor*) to 6 (*very good*)	5.24 (.85)	4.87 (.89)	5.05(.89)
Felt age	–.19 (.14)	–.14 (.12)	–.16 (.14)
ATOA possible range: 0 (*all negative*) to 1 (*all positive*)	.78 (.28)	.70 (.30)	.74 (.29)
AARC possible range: 194 (*low*) to 970 (*high*)			
Gains	277.79 (48.08)	259.42 (47.75)	268.30 (48.75)
Losses	228.07 (51.44)	223.59 (49.21)	225.75 (50.32)
Functional health (T-score)	47.07 (8.15)	48.68 (8.56)	47.89 (8.39)
Life satisfaction possible range: 5 (*low*) to 35 (*high*)	26.12 (6.18)	24.52 (5.99)	25.29 (6.13)

Note: ATOA = Attitude Toward Own Aging Scale. AARC = Awareness of Age-Related Change.

approximately 1 to 1½ hours. Both sites followed identical procedures for data collection, and all participants provided informed consent as required by institutional policies at the respective universities. No financial compensation was provided. Participants were free of self-reported memory complaints, and their primary language matched the language of the questionnaire (English or German).

Measures

To ensure consistency of measurement across countries, the questionnaire packet was formatted identically in the United States and Germany. Existing English and German versions have been used successfully in the literature for felt age (e.g., Westerhof & Barrett, 2005), ATOA (Moor, Zimprich, Schmitt, & Kliegel, 2006), SF-36 (Bullinger & Kirchberger, 1998), and SWLS (Schumacher, Klaiberg, & Brähler, 2003). A rigorous translation/back-translation process (involving four independent bilingual speakers, two of whom were native English speakers and two of whom were native German speakers) was employed for the AARC questionnaire to ensure that similar meaning was conveyed in both English and German.

Felt Age

Felt age was measured by the one-item question adapted from the National Survey of Midlife Development in the United States (MIDUS): "Many people feel older or younger than they actually are. Fill in the age (in years) that you feel most of the time: ___" (Barrett, 2003, p. S104). Answers were provided in whole numbers that represented ages, and a proportional discrepancy score between a person's actual chronological age and felt age was computed according to the procedures described by Rubin and Berntsen (2006). Calculating proportional discrepancy scores rather than absolute difference scores has the advantage that the difference between the actual and felt age can be expressed relative to a person's actual age. That is, a score of –.10 indicates that a person feels 10% younger relative to his or her actual age. The reliability and validity of this single-item measure of felt age are well established, nationally and cross-culturally (Barak, 2009).

Attitudes Toward Own Aging

Attitudes toward one's own aging were measured using the ATOA measure, a 5-item subscale of the Philadelphia Geriatric Center Morale Scale (Lawton, 1975). The items reflect an overall evaluation of an individual's aging experience and ask respondents to consider whether life is better or worse now compared with younger years. The response format for the items is dichotomous (better/worse, yes/no), and a higher score indicates a more positive view toward aging. Scores were summed and divided by the number of responses to devise a proportion score, such that a score of 1.00 reflected all positive responses and a score of 0.00 reflected all negative responses. The ATOA measure is widely used in SA research (Miche, Elsässer, Schilling, &

Wahl, 2014). Evidence for the unidimensional factor structure of the items was provided by Liang and Bollen (1983). The internal consistency reliability for the current sample was acceptable (Cronbach's α = .69).

Awareness of Age-Related Change

A long version (189 items) of a newly developed questionnaire was used to assess perceived age-related changes across five behavioral domains (Diehl & Wahl, 2010): health and physical functioning (PHYS); cognitive functioning (COG); interpersonal relations (INT), social-cognitive and social-emotional functioning (SC/SE); and lifestyle and engagement (LIFE). Items in each domain assess either positive (gains) or negative (losses) perceptions of age-related changes. The item stem is, "With my increasing age, I realize that … " and the response format ranges from 1 (*not at all*) to 5 (*very much*). A sample gain item (INT+ domain) is, " … my family has become more important to me." A sample loss item (LIFE-domain) is, " … I have not accomplished the things that I wanted to accomplish." Unit-weighted scale scores were calculated, such that higher scores reflect more age-related changes.

The psychometric properties of the AARC questionnaire are well supported in our sample (Diehl, Brothers, Wettstein, Miche, & Wahl, 2013). First, exploratory and confirmatory factor analyses support an overarching two-factor structure, representing perceived age-related gains and perceived age-related losses across all five domains. AARC gains and AARC losses scores are primarily used for the analyses reported here, although scale scores from the theoretically derived five behavioral domains are used for the domain-specific correlational analyses. In the present study, scale reliabilities were very good regarding the overarching dimensions and good regarding the behavioral domains (AARC gains: α = .96; AARC losses α = .96; 10 behavioral domains: α = .79–.92).

Functional Health

Functional health was measured using the Short Form 36 Health and Well-Being questionnaire, version 2 (SF-36v2; Ware et al., 2007). The SF-36 is widely used in public health studies and medical research. The physical component summary score was used, which represents a composite of four scale scores: physical functioning, ability to complete daily tasks, bodily pain, and general health. Items are rated on a 3- or 5-point rating scale, and a higher score represents better functional health. The reliability and validity of the SF-36 are well established (Ware et al., 2007), and the internal consistency reliability for the current sample was satisfactory (α = .83).

Satisfaction With Life

The satisfaction with life scale (SWLS; Diener, Emmons, Larsen, & Griffin, 1985) was used to measure subjective well-being. The SWLS includes five items, such as, *I am satisfied with the overall state of affairs in my life*. Items are rated on a scale from 1 (*strongly disagree*) to 7 (*strongly agree*). A higher score indicates greater satisfaction with life. The scale requires an overall cognitive evaluation of one's life and has been extensively used as an indicator of subjective well-being. Reliability and validity of this scale are well established (Diener et al., 1985). Cronbach's alpha in the present study was .87.

Demographic and Control Variables

Because the experience of aging has been shown to differ as a function of various demographic characteristics, such as socioeconomic status (Settersten & Hagestad, 2015), we included age, sex, education, and income as control variables. Education was classified into three categories based on the highest degree that was received: low (United States: high school degree or equivalent or below; GER: secondary school or below); medium (United States: Associate's or Bachelor's degree; GER: vocational training or associate degree); and high education (United States: Master's, Doctorate, Medical/Dental, or Law degree; GER: academic degree). A three-category variable was computed for low, medium, and high income, based on tertiles of the entire sample.

Analyses

Analyses were performed using SPSS (Version 22). We tested the main assumptions required for performing analyses based on the general linear model, including linear associations among variables, univariate and multivariate normality, and multicollinearity. Fifteen cases were identified as outliers (z-scored variable > 3.29; Tabachnick & Fidell, 2007). We conducted analyses twice: once with the outliers included and the other time with them excluded. Because the results of both sets of analyses were basically identical, we deemed that the outliers were not influential cases. Therefore, all outliers were retained for all analyses. Mediation and moderated mediation models were performed using the SPSS MEDIATE macro (Hayes, 2012), and moderated mediation models were estimated with the PROCESS macro for SPSS (Hayes, 2013). To evaluate the statistical significance of the indirect effects and conditional indirect effects, 10,000 bootstrapped samples were drawn and 95% confidence intervals were calculated. Confidence intervals that do not include zero indicate a statistically significant effect (Hayes, 2013). To evaluate the statistical significance of the indirect effects, 10,000 bootstrapped samples were drawn and 95% confidence intervals were calculated (Hayes, 2013). Due to problems with multicollinearity when the 10 behavioral AARC scale scores were used and for reasons of parsimony, the regression and mediation models were performed using the two overarching first-order factors of AARC gains and AARC losses.

Results

Research Question 1: Examining Associations Among the SA Constructs

Descriptive Statistics

Table 2 presents bivariate correlations among the SA constructs and the two developmental correlates. Overall,

Table 2. Bivariate Correlations Among the SA Measures, Developmental Outcomes, and Age

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
1. Felt age		−.26*	−.09*	.24*	−.10*	.24*	−.14*	.21*	−.001	.14*	−.09*	.22*	−.08*	.24*	−.21*	−.19*
2. ATOA			.12*	−.53*	.15*	−.49*	.12*	−.39*	.02	−.38*	.12*	−.49*	.15*	−.54*	.44*	.47*
3. Gains				.35*	.64*	.28*	.86*	.28*	.87*	.38*	.94*	.37*	.86*	.25*	−.06	.20*
4. Losses					.16*	.89*	.24*	.84*	.43*	.83*	.30*	.88*	.29*	.90*	−.51*	−.29*
5. PHYS+						.09*	.49*	.15*	.42*	.22*	.50*	.19*	.55*	.07*	.07*	.16*
6. PHYS−							.20*	.68*	.33*	.63*	.24*	.69*	.26*	.79*	−.58*	−.21*
7. COG+								.13*	.68*	.28*	.79*	.28*	.66*	.20*	−.02	.10*
8. COG−									.35*	.64*	.24*	.64*	.27*	.69*	−.36*	−.14*
9. INT+										.42*	.79*	.45*	.64*	.36*	−.14*	.12*
10. INT−											.32*	.74*	.31*	.70*	−.33*	−.20*
11. SCSE+												.31*	.75*	.23*	−.04	.18*
12. SCSE-													.27*	.75*	−.34*	−.34*
13. LIFE+														.14*	−.05	.27*
14. LIFE−															−.56*	−.38*
15. SF-36																.18*
16. SWLS																
Age	−.06	−.13*	.14*	.27*	.07	.25*	.06	.33*	.13*	.24*	.08*	.12*	.23*	.28*	−.28*	.14*

Note: *$p < .05$. Variables 5–14 refer to the AARC behavioral domain scores. "+" denotes an AARC gains domain; "−" denotes an AARC losses domain. COG = cognitive functioning; INT = interpersonal relations; LIFE = lifestyle and engagement; PHYS = health and functional health; SC/SE = social-cognitive/social-emotional functioning.

associations among the measures were in the expected directions. Correlations among the SA constructs ranged from no association to large effects. Felt age showed a small-to-medium correlation with ATOA (r = –.26, p < .001) and with AARC losses (r = .24, p < .001). ATOA showed a small association with AARC gains (r = .12 p < .001) and a large association with AARC losses (r = –.53, p < .001). The correlation between felt age and AARC gains reached statistical significance but did not represent a substantively meaningful relationship (r = .09, p = .014). AARC gains and AARC losses showed a medium-sized association (r = .35, p < .001). This pattern of findings suggests that, although the various constructs are related, they are also assessing different aspects of SA. In addition, the correlational findings suggest that SA captures something quite distinct from chronological age, as shown by correlation coefficients ranging in magnitude from .06 to .33.

The three SA constructs were associated with the developmental correlates to varying degrees, a pattern which supports the idea of differential contributions. The strongest correlation with functional health was found for AARC losses (r = –.51, p < .001). Satisfaction with life was most strongly associated with ATOA (r = .47, p < .001).

Going further, a pattern of domain specificity for the multidimensional construct of AARC was apparent in the bivariate correlations (Table 2). AARC in the domains of physical health (r = –.58; p < .001) and lifestyle and engagement (r = –.56; p < .001) both showed a strong association with the functional health outcome measure, likely reflecting increasing difficulty to engage in activities requiring certain physical abilities. Furthermore, AARC in the domains for interpersonal relationships (r = –.20, p < .001) and social-cognitive/social-emotional development (r = –.34, p < .001) showed the strongest associations with satisfaction with life, a pattern which reflects the importance of social-emotional development for well-being.

AARC as a Mediator Between Global SA and the Developmental Correlates

To evaluate the role of a behavior-specific SA measure (e.g., AARC) as a potential mediator of the association between global measures of SA (e.g., felt age, ATOA) and the developmental correlates, we performed four separate parallel multiple mediator analyses. Each analysis is described in detail in the following sections, and results are illustrated in Figure 1.

AARC as a Mediator Between Felt Age and Functional Health

Results of the mediation analysis showed that feeling older than one's chronological age predicted the awareness of more negative age-related changes, which, in turn, was associated with poorer functional health (Figure 1A). There was no significant association between felt age and AARC gains. The 95% bootstrapped confidence intervals sample

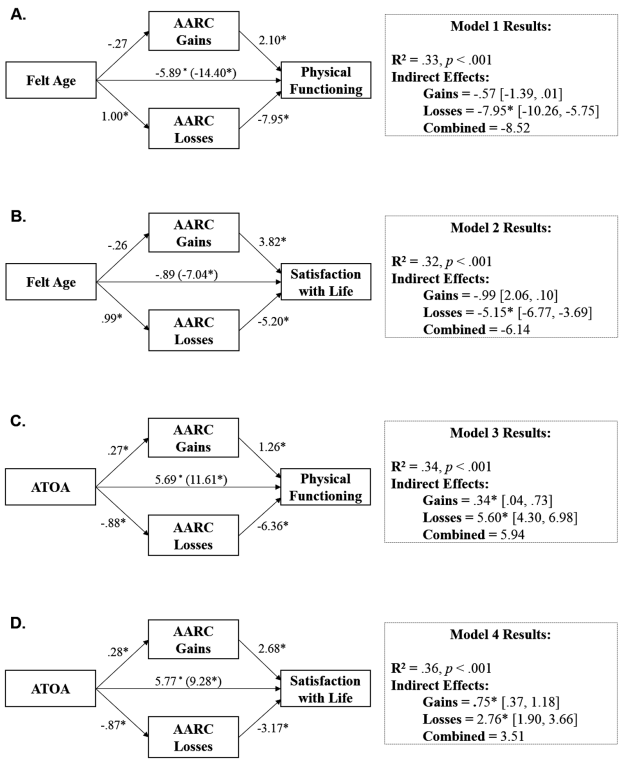

Figure 1. AARC Scales as mediators between global measures of subjective aging and two developmental correlates. Unstandardized regression weights are reported in accordance with Hayes (2013). Analyses control for age, sex, education, and income.

for the indirect effect through AARC losses did not include zero, indicating that the indirect effect through AARC losses was significantly different from zero. This model accounted for a significant amount of the variance in functional health (R^2 = .33, p < .001). The findings were indicative of partial mediation, as the direct effect of felt age on functional health was attenuated but remained significant when the mediators were added to the model. Calculating the ratio of the indirect effect to the total effect indicated that approximately 59% of the effect of felt age was mediated by AARC. These results supported the role of AARC losses as a partial mediator of the association between felt age and functional health.

AARC as a Mediator Between Felt Age and Satisfaction With Life

In the corresponding analysis with satisfaction with life as the outcome variable, we found that feeling older than one's chronological age was predictive of more AARC losses (but not of AARC gains), which was predictive of lower satisfaction with life (Figure 1B). The ratio of the indirect effect to the total effect indicated that approximately 87% of the effect of felt age was mediated by AARC. The indirect effect through AARC losses was significantly different from zero, indicating that AARC losses was a full mediator of the effect of felt age on satisfaction with life.

AARC as a Mediator Between ATOA and Functional Health

Results of this analysis showed that holding more positive ATOA predicted the perception of positive age-related changes (i.e., AARC gains), which was then associated with better functional health (Figure 1C). In contrast, holding more negative ATOA predicted the perception of more negative age-related changes (i.e., AARC losses), which was then associated with poorer functional health. The ratio of the indirect effect to the total effect indicated that approximately 51% of the effect of ATOA on functional health was mediated by AARC. The indirect effects through AARC gains and AARC losses were significantly different from zero, suggesting that both AARC scales functioned as partial mediators in the association between ATOA and functional health.

AARC as a Mediator Between ATOA and Satisfaction With Life

In the corresponding analysis related to satisfaction with life, we found that holding positive ATOA was predictive of more AARC gains, which was predictive of higher satisfaction with life (Figure 1D). Similarly, holding more negative ATOA was predictive of more AARC losses, which was then predictive of lower satisfaction with life. The ratio of the indirect effect to the total effect indicated that approximately 38% of the effect of ATOA was mediated by AARC. AARC gains and AARC losses served as partial mediators of the effect of ATOA on satisfaction with life, as the indirect effects were significantly different from zero.

Finally, the mediation models also provided evidence for the differential role of valence, as the indirect effect through AARC losses was relatively larger compared with the indirect effect through AARC gains. This finding provides further evidence to support our hypothesis that the awareness of negative age-related changes plays a stronger role in explaining the effect of negative implicit views of aging on negative developmental correlates than does the awareness of positive age-related changes.

Research Question 2: Moderated Mediation Analyses

Because our study sample covered a wide age range, we examined whether chronological age moderated the mediating pathways analyzed in Research Question 1. We performed conditional process analyses (Hayes, 2013) for each of the four models depicted in Figure 1 and tested the moderating effect of age on the indirect effect. The conditional effect was calculated for three levels of the moderator: the mean sample age and one standard deviation above and below the mean. Furthermore, because it is plausible to expect that age could exert its moderating effect on the pathway between global SA and AARC, or between AARC and the outcome, age was tested as a potential moderator on both individual pathways. To summarize the results of these analyses, the effect of global measures of SA on functional health through AARC depended on age, with this effect being stronger for older individuals. Age did not function as a moderator of the effect of global SA on well-being through AARC. The results from the significant models are described in the following sections and model coefficients are presented in Tables 3 and 4.

Age Moderation of Felt age to Functional Health Through AARC

As can be seen in Table 3, age did not moderate the pathways from felt age to AARC gains ($B = -1.53$, $p = .12$) or from felt age to AARC losses ($B = -1.31$, $p = .17$). Similarly, age did not function as a moderator on the direct effect from felt age to functional health ($B = -.01$, $p = .93$). However, age did moderate the pathway from AARC gains to functional health ($B = .001$, $p = .006$) as well as from AARC losses to functional health ($B = -.001$, $p = .001$). Specifically, the effect of AARC losses on physical function was stronger for older individuals. The conditional indirect effect of felt age on functional health was relatively stronger for older individuals (Table 4 and Figure 2).

Age Moderation of ATOA to Functional Health Through AARC

Age did not moderate the pathways from ATOA to AARC gains ($B = -.53$, $p = .26$) nor from ATOA to AARC losses ($B = .51$, $p = .21$). Similarly, age did not function as a moderator on the direct effect from felt age to functional health ($B = .03$, $p = .68$). However, age did moderate the pathway from AARC gains to functional health ($B = .001$, $p = .01$) as well as from AARC losses to functional health ($B = -.002$, $p = .01$). Specifically, the effect of AARC losses on physical function was stronger for older individuals. The conditional indirect effect of ATOA on functional health was relatively stronger for older individuals (Table 4 and Figure 2).

We generated two plots (Figure 2) to illustrate the nature of the moderating effect of age on functional health. Panel A depicts the conditional nature of the relationship between AARC gains and functional health at three levels of the moderator, and Panel B illustrates the relationship between AARC losses and functional health as a function of age.

Research Question 3: Examining the Predictive Relevance of the SA Constructs

Hierarchical linear regression was used to examine the predictive relevance of the three SA constructs with regard to the two developmental correlates (Table 5). This approach allowed us to examine whether the multidimensional measure of SA accounted for significant amounts of variance over and above the unidimensional measures as follows: In the first step, the control variables age, sex, education, and income were entered into the model. In Steps 2 and 3, the unidimensional SA measures were entered into the model,

Table 3. Age as a Moderator of the Mediating Pathway From Global SA to the Developmental Correlates Through AARC

Outcome	AARC gains		AARC losses		Functional health	
Predictor	*B* (*SE*)	*p* Value	*B* (*SE*)	*p* Value	*B* (*SE*)	*p* Value
Model 1						
Age	.29 (.22)	.19	**.89 (.21)**	**<.001**	**.21 (.10)**	**.046**
Felt age	67.32 (61.10)	.27	**175.21 (59.32)**	**.003**	−7.47 (9.23)	.42
AARC gains					−.06 (.03)	.06
AARC losses					.01 (.03)	.57
Felt age × Age	−1.53 (.99)	.12	−1.31 (.96)	.17	−.01 (.15)	.93
AARC gains × Age					**.001 (.0005)**	**.006**
AARC losses × Age					**−.0013 (.0004)**	**.001**
Model R^2	.041		.156		.339	
Model *F*	5.32	<.001	22.74	<.001	42.00	<.001
Model 2						
Age	**.98 (.36)**	**.01**	.49 (.31)	.11	−.11 (.15)	.45
ATOA	**59.10 (30.81)**	**.06**	**−118.31 (27.01)**	**<.001**	3.46 (5.61)	.54
AARC gains					**−.06 (.03)**	**.04**
AARC losses					.03 (.03)	.42
ATOA × Age	−.53 (.47)	.26	.51 (.41)	.21	.03 (.08)	.68
AARC gains × Age					**.001 (.001)**	**.01**
AARC losses × Age					**−.002 (.001)**	**.01**
Model R^2	.057		.321		.353	
Model *F*	7.61	<.001	59.52	<.001	40.98	<.001
Outcome	AARC gains		AARC losses		Satisfaction with life	
Predictor	*B* (*SE*)	*P* Value	*B* (*SE*)	*p* Value	*B* (*SE*)	*p* Value
Model 3						
Age	.29 (.22)	.17	**.89 (.21)**	**<.001**	.07 (.08)	.40
Felt age	66.41 (60.49)	.27	**172.67 (58.68)**	**.003**	−9.90 (7.03)	.16
AARC gains					.04 (.02)	.05
AARC losses					**−.08 (.02)**	**.0001**
Felt age × Age	−1.50 (.98)	.13	−1.27 (.95)	.18	.15 (.11)	.16
AARC gains × Age					.0000 (.0003)	.99
AARC losses × Age					.0004 (.0003)	.19
Model R^2	.041		.156		.328	
Model *F*	5.31	<.001	23.00	<.001	36.28	<.001
Model 4						
Age	**.97 (.34)**	**.005**	.43 (.30)	.15	.11 (.11)	.30
ATOA	58.14 (30.26)	.06	**−122.31 (26.55)**	**<.001**	**12.75 (3.99)**	**.001**
AARC gains					.02 (.02)	.45
AARC losses					−.04 (.02)	.08
ATOA × Age	−.50 (.46)	.28	.59 (.40)	.14	−.11 (.06)	.08
AARC gains × Age					.0002 (.0003)	.58
AARC losses × Age					.0002 (.0004)	.65
Model R^2	.058		.320		.371	
Model *F*	7.84	<.001	60.00	<.001	44.89	<.001

followed by the AARC gains and AARC losses scale scores together in the final step.

As shown in Table 5, AARC gains and AARC losses significantly predicted the developmental correlates over and above the control variables and the unidimensional measures felt age and ATOA. The control variables and unidimensional SA measures accounted for 26.6% of the variance in functional health, and the AARC scales accounted for an additional 7.6%. Regarding satisfaction with life, the control variables and unidimensional SA measures accounted for 31.0% of the variance, and the AARC scales accounted for an additional 5.3%. In both cases, the addition of the AARC scales represented a statistically significant change in R^2. Controlling for the other variables in the model, AARC losses was the strongest predictor of functional health ($\beta = -.37$, $p < .001$). With regard

Table 4. Conditional Indirect Effects of Subjective Age Measures on the Developmental Correlates Through AARC Gains and AARC Losses at Three Values of Chronological Age

	Functional health			Satisfaction with life		
	Age	Point estimate	95% CI	Age	Point estimate	95% CI
Felt age through AARC gains						
	50.85	–.10	[–.67, .09]	50.91	–.42	[–1.57, .67]
	63.64	**–.76**	**[–1.63, –.19]**	63.79	–1.23	[–2.27, –.24]
	76.43	**–2.06**	**[–4.32, –.64]**	76.67	–2.04	[–3.81, –.58]
Felt age through AARC losses						
	50.85	**–5.84**	**[–9.46, –3.81]**	50.91	–4.53	[–8.72, –4.25]
	63.64	**–6.53**	**[–10.10, –5.16]**	63.79	–3.38	[–6.69, –3.31]
	76.43	**–6.64**	**[–12.40, –3.45]**	76.67	–2.39	[–6.21, –1.54]
ATOA through AARC gains						
	50.89	–.01	[–.59, .47]	50.97	.88	[.40, 1.67]
	63.71	**.40**	**[.14, .83]**	63.87	.77	[.44, 1.20]
	76.52	**.59**	**[.12, 1.36]**	76.77	.63	[.18, 1.21]
ATOA through AARC losses						
	50.89	**4.37**	**[2.36, 6.58]**	50.97	3.10	[1.92, 4.49]
	63.71	**5.66**	**[4.36, 7.25]**	63.87	2.66	[1.79, 3.55]
	76.52	**6.69**	**[4.99, 8.87]**	76.77	2.25	[1.19, 3.49]

Note: 95% CI = 95% bias-corrected bootstrapped confidence interval. The three values of the moderator were selected to represent the mean ±1 *SD*.

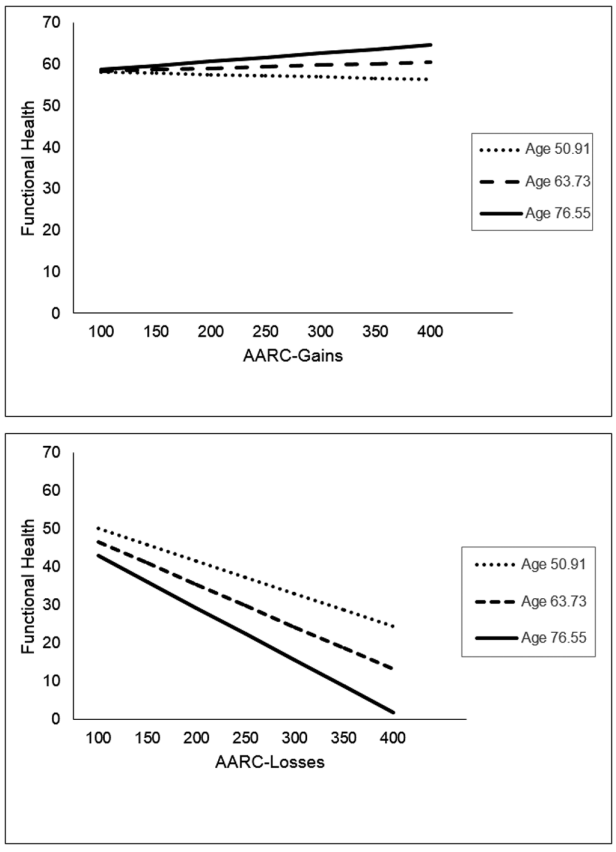

Figure 2. Interaction plots illustrating the moderating effect of age between AARC and functional health. AARC gains is illustrated in Panel **A**, and AARC losses is illustrated in Panel **B**. Using the pick-a-point approach, the conditional effects are estimated at three levels of the moderator. Analyses control for age, sex, education, and income.

to satisfaction with life, both AARC gains (β = .24, p < .001) and AARC losses (β = –.28, p < .001) were significant predictors after taking into account the control variables. The demographic variables chronological age (β = .28, p < .001) and income (β = .27, p < .001) were also comparably strong predictors of satisfaction with life. Felt age predicted functional health (β = .08, p < .05), but did not significantly predict satisfaction with life once the other SA measures were added to the model. ATOA was a significant predictor of functional health (β = .18, p < .001), and of satisfaction with life (β = .26, p < .001). Altogether, the predictors accounted for 34% of the variance in functional health, and 36% of the variance in satisfaction with life.

In order to determine the variance accounted for by the behavior-specific SA measures before adding the global measures into the model AARC, we repeated the above analyses by reversing the order of the subjective aging measures. AARC gains and AARC losses accounted for 21.9% of the variance in functional health and 19.6% of the variance in satisfaction with life, respectively, when entered before the other subjective aging variables. The unidimensional measures then added an additional 2.8% of the variance in functional health and 4.2% of the variance in satisfaction with life.

The regression results provided support for the differential effects of positive and negative valence (Table 5). Controlling for other variables in the model, AARC losses was a significantly stronger predictor of functional health (β = –.37) than was AARC gains (β = .07). With regard to the prediction of satisfaction with life, the AARC valences predicted the outcome in a comparable way (AARC gains β = .24; AARC losses β = –.28).

Table 5. Hierarchical Multiple Regression of Functional Health and Satisfaction With Life

	Functional health		Satisfaction with life	
	β	ΔR^2	β	ΔR^2
Step 1: Control variables		.095***		.126***
Age	−.16***		.28**	
Sex	−.02		−.03	
Education	.05		.03	
Income	.04		.27***	
Step 2: Felt age		.054***		.025***
Felt age	−.08*		.002	
Step 3: ATOA		.117***		.159***
ATOA	.18***		.26***	
Step 4: AARC		.076***		.054***
AARC gains	.08*		.24***	
AARC losses	−.37***		−.28***	
Total R^2	.342		.364	
Adjusted R^2	.335		.357	
F	47.92***		53.31***	

Note: * $p < .05$. ** $p < .01$. *** $p < .001$. Coefficients from the final step of the model are reported.

Discussion

Renewed interest in the topic of SA has been accompanied by increased variation in the conceptualization and measurement of its underlying constructs. The contributions of the present work include (a) providing new insights about the associations among three distinct SA constructs; (b) illustrating the conditional effect of chronological age upon such associations; and (c) showing how the three SA constructs differentially relate to functional health and satisfaction with life.

The first contribution of this study is the finding that felt age, ATOA, and AARC represent related, yet distinct facets of SA. Furthermore, we found support for the theoretical argument posited by Diehl and colleagues (2014) that a behavior-specific measure of SA (i.e., AARC) mediated the associations between more global measures of SA (i.e., felt age and ATOA) and measures of functional health and life satisfaction. A consistent pattern emerged across four mediation analyses: Holding global negative SA—in the form of feeling older than one's age or espousing negative attitudes about one's own aging—was associated with reporting more negative behavior-specific age-related changes, and this pathway was consistent with lower physical and psychological functioning. In the case of ATOA (but not felt age), there was also a significant mediating pathway through positive SA, such that more positive ATOA was associated with the awareness of more positive behavior-specific age-related changes (e.g., AARC gains), which was, in turn, predictive of better physical and psychological functioning.

The finding that AARC losses was a stronger mediating variable than AARC gains was consistent with previous research showing that negative SA tends to exert a stronger influence on behavioral outcomes than positive SA. For example, Hummert (2011) discussed that negative age stereotypes have considerable persuasive power in Western societies and, hence, can also be expected to become more behaviorally relevant than positive age stereotypes. Similarly, a meta-analysis showed that negative SA had about twice the influence on negative outcomes than positive aging attitudes had on positive outcomes (Meisner, 2012). Therefore, as others have argued, we also conclude that the negative constructions of one's own aging experience may be relatively more important for affecting behavioral outcomes than positive SA. Behavioral interventions represent one approach to counteracting the harmful effects of negative SA among adults, and these findings should be taken into account when designing such interventions. For example, it may be that mitigating negative loss-oriented views of aging results in stronger and more lasting intervention effects than strengthening a gain-oriented view of aging.

As a result of the mediation analyses, we found that more global measures of SA showed little to no association with the behavior-specific measures of positive SA (AARC gains). Therefore, we conclude that it is primarily the negative experiences that people draw upon when asked to evaluate their own aging experience in a spontaneous and global way, such as with felt age or ATOA. This is not to say, however, that positive experiences of aging are irrelevant; rather, we expect that cognitions about positive age-related changes simply require more deliberate and effortful processing and are not accessed as automatically as negative experiences.

Second, the present study contributes to the literature by illustrating that the associations between measures of SA and developmental correlates is conditional upon age. With the wide age range of our sample (40–98 years old), we found that with increasing age, the experience of more negative age-related changes is more strongly associated

with poorer functional health. Similarly, the experience of more positive age-related changes at an older age is more strongly tied to better functional health. One possible explanation for this finding is that, because physical and psychological resource losses become more severe at older ages, it might become increasingly difficult for older adults to counter the detrimental effects of negative views of aging, for example, through the use self-regulation strategies (Wurm, Warner, Ziegelmann, Wolff, & Schüz, 2013). The pattern of findings from the present study suggests that when it comes to the effects of AARC on developmental outcomes, functional health may be a more salient and self-relevant marker than life satisfaction. Such a finding underscores the importance of combatting negative views on aging throughout adulthood in order to minimize negative effects of SA on later life outcomes. To our knowledge, there is limited evidence to date regarding the moderating role of age on the association between SA and health and well-being. For instance, Spuling, Miche, Wurm, and Wahl (2013) found no evidence for differential effects of SA on health as a function of age. However, age was examined as a dichotomous variable, comparing middle-aged with older adults, and this approach may explain the lack of an age-moderation effect. Therefore, additional inquiry is warranted in this area.

A third contribution of the study is the finding that the three SA constructs showed differential predictive relevance with regard to functional health and satisfaction with life. As expected, the multidimensional SA measure, AARC, accounted for a significant amount of variance in the outcome variables over and above the unidimensional SA constructs. We found evidence for a pattern of domain specificity in that SA specific to physical functioning had a relatively stronger predictive association with the functional health outcome variable. Similarly, there was a differential valence effect in that negative SA predicted functional health much more strongly than did positive SA. Interestingly, there was no effect of valence for predicting satisfaction with life, as both positive and negative SA coefficients were of similar magnitude.

Limitations and Future Directions

A few limitations must be considered. First, the nature of the sample carries some limitations. It should be kept in mind that the current data are cross-sectional and correlational in nature. A more definitive analysis of the causal mechanisms in the interplay between measures of SA and developmental outcomes will require longitudinal extensions (Preacher, 2015). For instance, it remains to be tested whether opposite mediating pathways may exist: Does poorer (better) functional health lead to more awareness of negative (positive) age-related changes which then leads to more negative (positive) global subjective aging? Another limitation of the sample is that it includes individuals in relatively good health, and therefore, the relationships between SA and the developmental correlates is not representative of individuals experiencing significant health problems.

A second limitation of the study is that it is impossible to untangle differential effects of chronological age and cohort given the present sample. We included a wide age range and used age 40 as the entry age into our study as an indicator of entering midlife—a life phase when reflections about one's own age and aging start to increase noticeably (Dörner, Mickler, & Staudinger, 2005). With regard to cohort issues, it may be the case that cohort effects are present because current cohorts of old and very old adults may have internalized more negative views of aging than more recent cohorts of adults such as the baby boom cohort, given tendencies of this generation to eschew traditional social conventions (Miche, Brothers, Diehl, & Wahl, 2015). However, longitudinal data are needed to explore the nature of cohort differences and similarities. Third, we focused on only three well-established measures of SA. As Diehl and colleagues (2014) have shown, there are additional SA measures available, including some multidimensional measures (e.g., Steverink et al., 2001). Whether the findings reported here can be generalized to these other measures remains an open question.

Because we expected an overall similar pattern of findings in the U.S. and German samples (Barak, 2009; Löckenhoff et al., 2009), we conducted analyses in the aggregate. However, the examination of cultural similarities and differences will become a focus of future work, in which we examine potential differences and similarities between the subsamples in order to provide insight into the more subtle cultural nuances in SA. Some differences in SA may be expected due to differing political structures, described as a neoliberal market orientation in the United States and a social welfare state in Germany (Staudinger, 2015). To the extent that these political structures provide the background within which individuals' personal aging expectations are formed, it seems reasonable to expect some cultural differences. Furthermore, previous research has shown that in the United States, a younger age identity is more strongly related to facets of well-being such as life satisfaction, positive affect and negative affect, whereas in Germany, well-being is not as strongly tied to age identity (Westerhof & Barrett, 2005). The present sample allows for the examination of cross-cultural differences between the United States and Germany on several SA measures.

Testing the associations among different measures of SA and their predictive relevance regarding developmental correlates represents one necessary step to clarify conceptual similarities and differences of alternative SA constructs (Diehl et al., 2014). A clearer understanding of how these varying measures function with regard to different outcome variables will help to inform future use of these measurement instruments. Such clarification is also important from a conceptual standpoint, as future research is needed for designing effective programs to help individuals avoid the internalization of negative beliefs about aging.

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