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Measurement Article

Measuring Awareness of Age-Related Change: Development of a 10-Item Short Form for Use in Large-Scale Surveys

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Abstract

Background and Objectives: Existing measures of subjective aging have been useful in predicting developmental outcomes. Unlike other constructs of subjective aging, Awareness of Age-Related Change (AARC) focuses on how adults' self-perceptions of aging result in an awareness of age-related gains and losses. We developed a 10-item short form (SF) of the existing 50-item AARC questionnaire as a reliable, valid, and parsimonious solution for use primarily in large-scale surveys but also in applied contexts.

Research Design and Methods: AARC was assessed in a German and North American sample of 819 individuals. Item selection for the suggested AARC-10 SF was based on multidimensional item response theory (MIRT). Multi-group confirmatory factor analysis (CFA) was used to test for measurement invariance (MI) across groups of participants in middle age (40–69 years), early old age (70–79 years), and advanced age (80+ years). Concurrent and discriminant validity in old age was assessed with regard to established measures of subjective aging, well-being, and health.

Results: The AARC-10 SF showed adequate fit to the data and reliability for the perceived gains and losses composites. Valid comparison of latent means was confirmed for early old and advanced age respondents and with some reservation also for middle-aged individuals due to partial MI. Concurrent and discriminant validity were confirmed.

Discussion and Implications: The proposed AARC-10 SF offers an economic device to measure AARC and use the construct as an antecedent or outcome in the context of substantive model testing in large-scale survey data.

Keywords: Self-Perceptions of Aging, Adult Development, Multidimensional Item Response Theory

Adults experience their aging in very diverse ways and, thus, a subjective aging component can add value to the objective assessment of the aging process. Empirically, a large body of evidence supports the notion that measures of subjective aging are significant predictors of key developmental outcomes. For example, a recent meta-analysis integrating the results of 19 longitudinal studies, mostly using a subjective age measure such as felt age or the Attitudes Toward Own Aging—ATOA scale, found an overall significant effect of subjective aging on a range of health-related outcomes (Westerhof et al., 2014).

In recent years, renewed interest in conceptualizations of and empirical research on subjective aging in the fields

of life span psychology, social gerontology, and life course sociology has flourished (Diehl & Wahl, 2015). For example, stereotype embodiment theory was proposed as a psychological framework to better understand the individual and societal phenomena of age-related stereotyping, self-stereotyping, and ageism (Levy, 2009). Similarly, Montepare (2009) elaborated on theoretical issues related to subjective aging, covering the age range from adolescence to old age.

Diehl and Wahl (2010) proposed the construct of *Awareness of Age-Related Change (AARC)* to better address the self-reflective and multidimensional nature of adults' subjective aging experiences. According to the definition provided by the authors, AARC refers to "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). AARC represents a novel approach to the assessment of subjective aging for several reasons. First, AARC addresses a more conscious and behavior-based form of individuals' understanding of their own aging and, therefore, represents a form of self-knowledge. Thus, the concept of AARC rests on the assumption that such self-knowledge can be brought to explicit awareness through appropriate priming, such as the items on a questionnaire.

Second, AARC was conceptualized as a multidimensional construct in terms of the *valence* of adults' age-related self-perceptions. That is, the questionnaire was designed with the intention to capture *a priori* both positive and negative self-perceived age-related changes in behavior, level of performance and ways of experiencing life. That is, drawing on life-span theorizing and empirical research (e.g., Baltes, Lindenberger, & Staudinger, 2006; Heckhausen, Dixon, & Baltes, 1989), the concept of AARC rests on the assumption that aging is characterized by both gains and losses. Previous measures have predominantly relied on a single item (e.g., subjective age expressed in years) or a small number of items that assess a unidimensional view of subjective aging (ATOA, Lawton, 1975; see also Miche, Elsässer, Schilling, & Wahl, 2014). These measurement approaches do not take into account that a person's experience of aging may differ across different life domains. Diehl and Wahl (2010) identified five behavioral domains in which AARC may be most salient: Health and physical functioning, cognitive functioning, interpersonal relations, social-cognitive and social-emotional functioning, and lifestyle and engagement. The AARC questionnaire was designed to assess the positive and negative age-related changes that may occur in these behavioral domains (Brothers, Gabrian, Wahl, & Diehl, submitted).

In support of these theoretical assumptions, AARC has empirically been found to account for unique portions of variance in measures of well-being and health-related outcomes above and beyond the variance accounted for by established subjective aging measures (Brothers, Gabrian, Wahl, & Diehl, submitted). AARC has also been found to predict depressive symptoms across 2.5 years in a middle-aged and older adult sample (Dutt, Gabrian, & Wahl, 2016). Furthermore, Brothers, Gabrian, Wahl, & Diehl, submitted showed that feeling older and holding more negative attitudes toward one's own aging was associated with a greater awareness of negative age-related changes, which, in turn, was associated with poorer functional health. Supporting the notion that perceptions of positive age-related changes may motivate individuals to engage in health-promoting behaviors, Brothers, Gabrian, Wahl, and Diehl (2016) found that awareness of age-related gains moderated the negative relation between a limited future time perspective and well-being.

Need for a Short Assessment of AARC

Using AARC in Survey Research

To date, the assessment of AARC has relied on rather long questionnaires, starting with a 189-item scale designed for research purposes in the subjective aging area (Brothers, Miche, Wahl, & Diehl, 2017). In addition, our research team has developed a 50-item questionnaire to facilitate the use of the AARC measure in a variety of research contexts (Brothers, Gabrian, Wahl, & Diehl, submitted) (The full 50-item version is available on request from the authors.). However, even this 50-item questionnaire is too long for use in large-scale surveys where time constraints and response burden are a major issue. In addition to being cost-effective, a valid, reliable, and sensitive AARC short form (SF) would also minimize the response burden for more vulnerable respondents, facilitating the study of more representative samples, especially in the hard-to-survey old, and very old population (Feskens, 2009).

In light of the evidence for significant and meaningful effects of AARC on developmental outcomes, such as well-being and functional health, the importance of capturing inter-individual differences in AARC between age groups and trajectories of AARC over time becomes obvious. For both research purposes establishing measurement invariance (MI) is a critical requirement (Mellenbergh & van den Brink, 1998). With the adoption of a life-span view on human development, aging researchers have become increasingly interested in MI properties of assessment instruments and new options for interpreting lack of MI are currently discussed (for an overview, see van de Schoot, Schmidt, Beuckelaer, Lek, & Zondervan-Zwijnenburg, 2015). Edwards and Wirth (2009) point out that shifting item thresholds, if in line with theories about developmental processes, can add to the validation of a measure. For example, with regard to AARC it seems reasonable to assume that individuals' awareness of aging may be transformed by behavioral experiences and changes in their social and/or physical environments across the adult life span.

Application of a Short Scale in Applied Areas

We assume that a short AARC scale also has direct and beneficial applications across multiple fields, including

psychological consultation, health promotion, and prevention. As already stated, a considerable amount of evidence links subjective aging to a host of outcomes in adulthood relevant for healthy and successful aging (Westerhof et al., 2014). Specifically, individuals who have more positive views of aging—for instance those who expect positive experiences and opportunities for growth—are more likely to maintain better physical functioning, recover faster from disability, have better memory performance, and live an average of 7.5 years longer (Levy, Slade, Kunkel, & Kasl, 2002; Levy, Slade, Murphy, & Gill, 2012; Sargent-Cox, Anstey, & Luszcz, 2012; Stephan, Caudroit, Jaconelli, & Terracciano, 2014). In the clinical or counseling arena, a short AARC questionnaire may be used to identify individuals who are prime candidates for intervention and thus may serve as an important diagnostic instrument.

Study Goals

This study had two objectives: (1) Using data from the existing 50-item version of the AARC questionnaire to identify a 10-item AARC SF representing both gain- and loss-related change experiences. The 10 items were expected to meet a number of psychometric criteria, such as internal consistency, the representation of the gains and losses dimensions at the latent level, and MI across age groups. (2) To examine how the obtained SF behaved vis-à-vis other established subjective aging measures and as a correlate of a range of developmental outcomes. In particular, we expected moderate associations with felt age and attitudes towards own aging as well as substantive associations with measures of well-being and health-related outcomes. Given our previous findings (e.g., Brothers, Gabrian, Wahl, & Diehl, submitted) as well as a consistent finding in the subjective aging and age stereotype literature (Meisner, 2012) that negative indicators of subjective aging are more strongly related to outcomes compared to positive indicators of subjective aging, we also expected a similar pattern with the AARC SF.

Research Design and Methods

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 (48.4%) and Germany (51.6%). Pooled data were used for this study to assure stable parameter estimation of the likelihood-based MIRT analysis. The mean differences reported between the two samples were small in terms of practical significance for the measures most relevant for this psychometric study (Diehl, Brothers, Wettstein, Miche, & Wahl, 2013).

Descriptive statistics of demographic variables and key constructs for the overall sample and the age groups under study are given in Supplementary Table 1. Age groups in this study were defined as middle-aged (40–69 years), early old (70–79 years), and advanced age (80–98 years). This differentiation is in line with data when people start to feel old, which is more around 70 years than 65 years currently (Choi, DiNitto, & Kim, 2014). In addition, we aim at comparing those in their "first phase" of feeling old (70–79 years) to those already long-time in the "aging phase" (Miche, Wahl et al., 2014). The advanced age group had the highest share of men (47.6%). The presence of a spouse decreased across age groups, leaving 40.7% of persons from the oldest group married at the time of the study. Compared to middle-aged respondents, more early-old and advanced old age individuals showed low levels of education (26.2 and 26.3%, respectively). Less than 30% of the middle-aged adults were retired, whereas in the early-old and advanced-old subsamples, less than 10% of respondents reported being employed. With respect to demographic background variables, the early-old and advanced old age groups were more similar to each other compared to the younger subsample.

Participants were recruited by posting study announcements in public locations, such as bulletin boards in public libraries, and by word of mouth. They completed a self-report questionnaire packet, which took approximately 1 to 11/2 h. Both study sites followed identical protocols for data collection, and all participants provided informed consent as required by institutional policies at the respective universities.

Measures

Awareness of Age-Related Change

The existing 50-item version of the AARC instrument was used to assess perceived age-related changes across five behavioral domains (Brothers, Gabrian, Wahl, & Diehl, submitted; 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). Half of the 10 items in each domain assess positive (gains) and negative (losses) perceptions of age-related changes, respectively. 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." Details on the psychometric properties of the original AARC-50 scale in this sample have been reported elsewhere (Brothers, Gabrian, Wahl, & Diehl, submitted; Diehl et al., 2013). Reported scale reliabilities were very good in terms of the two overarching target dimensions of perceived age-related gains and losses (each α = .96).

Felt Age

Felt age was measured with the single item 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). 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). The reliability and validity of this single-item measure of felt age are well established within and across cultures (Barak, 2009).

Attitudes Toward Own Aging

Attitudes toward one's own aging were measured using the ATOA measure, a five-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 to younger years. The response format for the items is dichotomous (*better/worse*, *yes/no*), and scores were summed and divided by the number of responses to devise a proportion score. Hence, a score of 1.00 reflected all positive responses and a score of 0.00 reflected all negative responses. The internal consistency reliability for the current sample was acceptable (Cronbach's $\alpha = .69$).

Functional Health

Functional health was measured using the SF 36 Health and Well-Being questionnaire, version 2 (SF-36v2; Ware et al., 2007). The physical component summary score represents a composite of four scale scores: Physical functioning, ability to complete daily tasks, bodily pain, and general health. The mental component summary score includes energy, emotional role functioning, social role functioning, and psychological well-being. Items are rated on a three- or five-point rating scale, and a higher score represents better functional health. Internal consistency reliability for the current sample was satisfactory for the mental ($\alpha = .87$) and physical ($\alpha = .83$) subscales. In addition, subjective health was measured with a single item with responses ranging from 1 (*very poor*) to 6 (*very good*).

Psychological Well-Being

The Satisfaction with Life Scale (SWLS; Diener, Emmons, Larsen, & Griffin, 1985) was used to measure hedonic 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. Cronbach's alpha in the present study was .87.

The Ryff Scales of Psychological Well-Being (SPWB; Ryff, 1989) were included as measures of eudaimonic well-being. The SPWB assesses six facets of human positive functioning and self-realization: Autonomy, Personal Growth, Self-Acceptance, Purpose in Life, Environmental Mastery, and Positive Relationships. Each scale consists of up to nine items that are rated on a scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*). Cronbach's alpha for subscales ranged between .63 and .86, replicating previous findings of different degrees of heterogeneity in psychological well-being and measurement precision of its subscales (Abbott, Ploubidis, Huppert, Kuh, & Croudace, 2010).

Depressive Symptoms

Depressive symptomatology was measured using the Center for Epidemiologic Studies Depression Scale Revised (CES-D-R10). Items are rated on a four-point scale from 0 (*rarely or none of the time*) to 3 (*all of the time*). Cronbach's alpha in this sample was .85.

Strategy of Analysis

We decided a priori that a 10-item scale would be the absolute minimum to fully represent both the multi-directionality (i.e., perceived age-related gains and losses) and multi-dimensionality (i.e., five behavioral domains) of the concept of AARC. Nevertheless, five items per gain and loss component should allow for a reliable and valid estimation of the AARC gain–loss overarching dimension. Finally, we expected that 10 items would be acceptable for an economic measurement device in general.

To identify a set of items appropriate for a short version of the AARC-50, we applied IRT methodology to gain detailed insights into the functioning of individual items in the response space of the 50-item scale. In addition to item discrimination (i.e. factor loading in classical test theory), we put additional emphasis on item difficulty and the range of perceived AARC gains or losses covered by an item's response categories.

Addressing the AARC response data in the IRT framework, however, poses a number of challenges. First, because the AARC-50 items offer five response categories, the statistical model for the response process has to be able to deal with polytomous data. Second, we would not expect item discrimination to be the same across behavioral domains like health and lifestyle. Therefore, the two-parameter Generalized Partial Credit Model (Muraki, 1992) was considered the best representation of our expectations about the relationship between respondents' AARC experience and their choice of response categories for each of the 50 items. Third, with multiple target dimensions of age-related experience (i.e., gains and losses), a multidimensional item response (MIRT; Hartig & Höhler, 2009) model needs to be estimated. With the AARC-50, responses to individual items show within-item multidimensionality because they are dependent on two factors at a time (e.g., gains [in the] cognitive domain). In summary, a MIRT model comprising two target dimensions (i.e., perceived gains and losses) and five domain-specific factors (e.g., physical or cognitive function) was considered the most appropriate representation of a measurement model of perceived age-related change.

The one most discriminative indicator of either perceived AARC gains or losses from each of the five behavioral domains was selected for the 10-item AARC SF instrument. The construction of the proposed AARC-10 SF

instrument was based on the full sample, including middle-aged adults (40–69 years) to have the best empirical basis for the estimation of item characteristics from the response data. Therefore, the fit of the SF to the response data and scale reliability (McDonald, 1999) were explicitly tested in the early-old and advanced old age subsample as this was the main focus of the current study. These subpopulations are considered particularly difficult to address in survey research.

Measurement invariance of the proposed SF questionnaire was tested across potentially qualitatively different periods of the life course. First, age groups "70–79 years" (i.e., equivalent to early old age) and "80 years and above" (i.e., equivalent to advanced old age) were considered to test MI across a segment of the life span for which AARC may be considered conceptually similar and valid age group comparisons seem reasonable. In the second step, the focus was extended to include a broader age range of respondents aged 40–69 years (i.e., equivalent to midlife) to examine potential differences in the concept of AARC from a developmental perspective. MI was tested using a set of multigroup CFA models with cross-group constraints (Byrne, Shavelson, & Muthén, 1989; van de Schoot, Lugtig, & Hox, 2012). All analyses were conducted using a structural equation modeling (SEM) framework and Mplus 7.4 software.

Results

Descriptive Statistics

Regarding study variables, the early-old and advanced old age subsamples were more similar to each other than to participants in midlife (Supplementary Table 1). However, the oldest group of respondents reported significantly less favorable attitudes toward own aging than both the midage and early-old subgroups, whereas no age effect was observed for felt age. With respect to well-being outcomes, the early-old and advanced old age subsamples reported higher life satisfaction, autonomy, environmental mastery, and self-acceptance than the midlife subgroup. In the realm of health outcomes, the physical component indicated significantly decreasing levels of functioning across all three age groups.

MIRT Item Diagnostics for the Original AARC-50 Instrument

Similar to what has been reported from earlier CFAs regarding the factorial structure of the 50-item AARC questionnaire (Brothers, Miche et al., 2017; Diehl et al., 2013), the estimated latent correlation between perceived age-related gains and losses was small and positive ($r = .22$, $SE = 0.042$). All indicators were significantly related to their respective losses and gains dimension, with almost all items showing appropriate discriminatory power (Supplementary Table 2). Not all of the items, however, were also significantly related to their respective life domain factor. Most of the domain factors were related almost exclusively to either all-positive items (i.e., PHYS and LIFE domains) *or* all-negative items (i.e., COG, INT, and SCSE domains), and hence, were dominated by either a gain (e.g., embracing lifestyle opportunities) or a loss (e.g., suffering social neglect) perspective.

For AARC gains, item thresholds were spread evenly across the entire continuum of gains scores (Figure 1, top panel). All items were able to discriminate between respondents below and above the average level of AARC gains. However, there were fewer category thresholds for items of the INT domain located at lower levels of perceived age-related gains, and hence lower sensitivity for subtle age-related changes in this domain. For perceived age-related losses, only few item thresholds fell in the range of low to average AARC losses. Hence, the AARC-50 appears to be particularly well-suited to measure higher levels of loss-related AARC. More pronounced levels of age-related losses, however, were rarely observed in the present sample.

Item Selection

Item parameter estimates from the comprehensive GPCM model of gains and losses (see Figure 1; Supplementary Table 2) were used in the item selection process for the AARC-10 SF. To retain the theoretical structure of the concept of AARC, two items per behavioral domain were

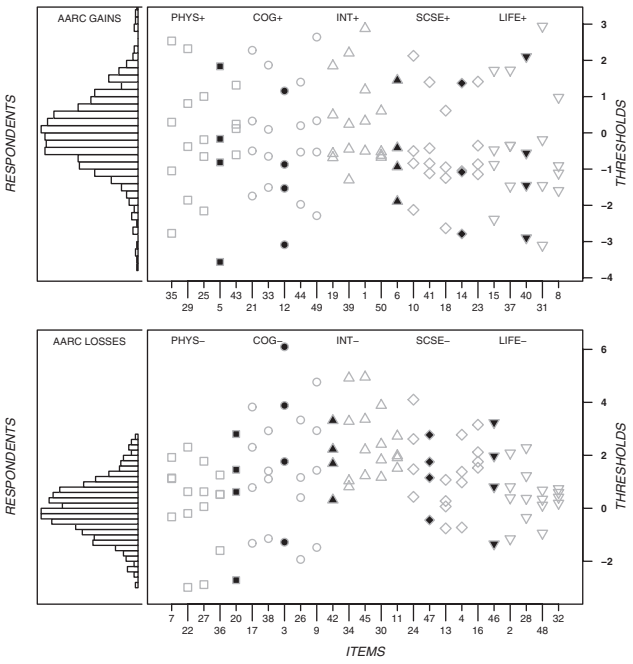

Figure 1. Distribution of perceived AARC losses and gains in the full sample and distribution of response category thresholds in items from different behavioral domains. All parameter estimates are person-centered, i.e., a value of 0 on the logit scale refers to the mean of the respective propensity distribution of perceived gains and losses and a value of –1 represents one standard deviation below the mean. Items selected for the AARC-10 SF are highlighted.

selected, with one reflecting a gain-related experience and the other reflecting a loss-related experience. The majority of these items—in addition to being the most discriminating item with respect to the gains or losses factor—showed significant loadings also on their respective domain factor.

With respect to item thresholds, the five selected items from the gains domain (highlighted in the upper panel of Figure 1) cover a broad range of different levels of perceived age-related gains. The set of items for measuring AARC losses were also very much representative of the range of AARC levels typically covered by their respective behavioral domain. Taken together, the item subset selected for the AARC-10 SF covered the perceived age-related gains and losses across a reasonable range of the latent target domains with satisfying precision.

Psychometric Properties of the Proposed AARC-10 SF

The relative model fit and estimated reliabilities for the gains and losses composites in both the full sample (40+) and a combined old age subsample (70+) suggested that the proposed AARC-10 SF was useful for assessing AARC in an age-diverse population (see Table 1). Composite reliabilities were consistently higher for age-related losses, but were adequate throughout, given the small number of indicators from multiple behavioral domains.

Item characteristics for the proposed 10-item version in the early-old and advanced old age subsample combined are displayed in Table 2. On average, respondents did report "quite a bit" of age-related gains experiences (M = 3.5–3.8), whereas lower levels of age-related loss experiences (M = 2.1–2.9) were reported across all behavioral domains. Nevertheless, especially with respect to PHYS and LIFE, "moderate" levels of perceived age-related losses were reported. The amount of missing information in the selected items was negligible (<1.1%), supporting the validity of item content for this age group. In addition, no ceiling or floor effects were observed, indicating the appropriateness of the offered response categories. The pattern of standardized loadings indicated a certain degree of heterogeneity in the latent gains and losses constructs as a result of the theory-driven subdomain structure of the instrument. Yet, the association between construct and indicators was reasonably strong for all items (i.e., standardized loadings >.40).

With respect to MI, compared to a baseline model with factor loadings and item intercepts freely estimated in each age group (Table 3, M0: χ^2 = 215.03, df = 102, p < .001), restricting factor loadings to be the same across all three age groups did not increase model misfit substantially (M1:

Table 1. Model Fit of the Two-Dimensional AARC-10 SF in the Full Sample and Old Age Subsample

Sample	Absolute fit	Relative fit indices	Composite reliability
Total (40+ years) sample	χ^2 = 141.39, df = 34, p > .001	RMSEA = 0.062, 90%CI [0.052, 0.073], p = .029, CFI = 0.95, TLI = 0.93	Gains: ω = .72, 90%CI [.69, .75] Losses: ω = .80, 90% CI [.78, .82]
Old age (70+ years) subsample	χ^2 = 73.54, df = 34, p < .001	RMSEA = 0.067, 90%CI [0.046, 0.087], p = .092, CFI=0.93, TLI = 0.91	Gains: ω = .71, 90%CI [.65, .77] Losses: ω = .79, 90% CI [.75, .82]

Table 2. Item Characteristics of the Proposed 10-Item Short Version (AARC-10 SF) in the Early and Advanced Old Age Subsample

Items selected for the AARC-10 SF			Basic item characteristics						Standardized factor loading	
Domain[a]	Item	With my increasing age, I realize that …	N	Mean	SD	% min[b]	% max[b]	N_{miss}	Losses	Gains
PHYS+	5	…I pay more attention to my health	261	3.53	1.17	2.68	19.92	2	—	.50
COG+	12	…I have more experience and knowledge to evaluate things and people	263	3.84	0.92	2.28	26.24	—	—	.55
INT+	6	…I appreciate relationships and people much more	263	3.49	1.24	6.84	18.63	—	—	.59
SCSE+	14	…I have a better sense of what is important to me	261	3.72	1.17	3.83	24.52	2	—	.75
LIFE+	40	…I have more freedom to live my days the way I want	262	3.81	1.28	5.34	30.92	1	—	.49
PHYS-	20	…I have less energy	261	2.92	1.21	4.60	11.49	2	.75	—
COG–	3	…my mental capacity is declining	261	2.23	0.92	22.61	1.92	2	.58	—
INT–	42	….I feel more dependent on the help of others	263	2.13	1.10	32.70	2.66	—	.60	—
SCSE–	47	…I find it harder to motivate myself	260	2.24	1.06	26.92	2.31	3	.62	—
LIFE–	46	…I have to limit my activities	263	2.77	1.19	11.03	7.22	—	.71	—

[a]AARC Domain Abbreviations: PHYS = Health and Physical Functioning; COG = Cognitive Functioning; INT = Interpersonal Relations; SCSE = Social-Cognitive and Social-Emotional Functioning; LIFE = Lifestyle and Engagement; "+" = positive domains; "–" = negative domains. [b]Numbers refer to the percentage of participants choosing the minimum/maximum score on the five-point scale.

Table 3. Response Shift of AARC-10 SF Scale and Indicators Across Age Groups

		Baseline model		Model comparison								
		M0 no constraints		M2 equal intercepts			M2_1 equal intercepts: 80–89 years = 70–79 years			M2_2 equal intercepts: 70–79 years = 40–69 years		
Domain[a]	Item	χ^2	df	$\Delta\chi^2$	Δdf	*p*	$\Delta\chi^2$	Δdf	*p*	$\Delta\chi^2$	Δdf	*p*
PHYS+	5	215.03	102	11.523	2	.003	0.01	1	.913	7.66	1	.006
PHYS–	20	215.03	102	34.289	2	<.001	8.56	1	.003	6.39	1	.011
COG+	12	215.03	102	11.475	2	.003	7.25	1	.007	10.61	1	.001
COG–	3	215.03	102	16.996	2	<.001	3.46	1	.063	4.05	1	.044
INT+	6	215.03	102	3.158	2	.206	—	—	—	—	—	—
INT–	42	215.03	102	62.907	2	<.001	16.31	1	<.001	11.67	1	.001
SCSE+	14	215.03	102	4.527	2	.104	—	—	—	—	—	—
SCSE–	47	215.03	102	20.139	2	<.001	3.49	1	.062	5.03	1	.025
LIFE+	40	215.03	102	56.085	2	<.001	2.83	1	.092	46.98	1	<.001
LIFE–	46	215.03	102	71.427	2	<.001	4.67	1	.031	28.51	1	<.001
AARC-10 SF	ALL	215.03	102	160.728	20	<.001	29.78	10	.001	74.01	10	<.001

Note: COG = Cognitive Functioning; LIFE = Lifestyle and Engagement; PHYS = Health and Physical Functioning; INT = Interpersonal Relations; SCSE = Social-Cognitive and Social-Emotional Functioning. "+" positive domains; "–" = negative domains.

[a]AARC domain.

$\Delta\chi^2 = 19.55$ $\Delta df = 20$, $p = .486$). Hence, the meaning of the concept of AARC as captured by the AARC-10 SF appeared to be the same across the age span considered in this study, allowing for valid representation of AARC gains and losses in correlational studies covering a wide range of the adult life span. Testing for equality of scale of measurement across age groups, however, revealed evidence of response shift (i.e. diverging interpretations of answer categories) across respondents aged 40–69 years and 70–79 years, as well as between respondents aged 70–79 years and 80+ years (Table 3).

Examining Response Shift in AARC-10 SF Items Across Early and Advanced Old Age

Differences in the use of the five-category response scale were observed for early-old and advanced old respondents with respect to age-related losses in the PHYS, INT, and LIFE domains, as well as with respect to gains reported in the COG domain (Table 3, M2_1). Specifically, respondents in the oldest group (80+) reported higher levels of energy loss than younger respondents who had exactly the same estimated level of perceived AARC losses. A comparable response shift was observed with respect to the dependency on the help from others and the need to limit activities. In contrast, the advanced old were less inclined to report more experience and knowledge to evaluate things and persons with increasing age compared to respondents aged 70–79 years. Nevertheless, the magnitude of bias that would result from ignoring response shift in estimating latent means for both perceived gains and losses was found to be very small in the early-old (Cohen's *d*: 0.027 and –0.050) and advanced old age group (Cohen's *d*: –0.038 and 0.049). Hence, detection of even small latent mean differences between these groups will not be compromised.

In sum, the AARC-10 SF appears to be well-suited to measure the perception of age-related gains comparably across the groups of early and advanced old age. Because the meaning of AARC gains (i.e., factor structure) was the same in both groups and age bias with respect to the interpretation of the response categories was restricted to the COG domain, valid comparisons across age groups are assured. Similarly, the concept of perceived AARC losses was substantiated by our data to be comparable across early and advanced old age. However, given the evidence of response shift for some domains, caution should be used when comparing *observed sum scores* across early-old and advanced old age and estimating latent means is recommended instead.

Examining Response Shift in AARC-10 SF Items Across a Wider Segment of the Adult life Span Including Mid-Life

For both dimensions, perceived age-related gains and losses, a positive age bias (i.e., participants aged 70–79 years chose higher response categories more readily than middle-aged participants) was observed in almost all behavioral domains. Hence, the possibility to statistically control for response shift in comparing latent levels of AARC was significantly reduced, and minor overestimation of age differences is expected when expanding the use of the AARC-10 SF to include the middle age population (see Table 3, M2_2).

Validity Evidence for Using the AARC-10 SF in Early and Advanced Old Age

Convergent validity was evident from correlations between the AARC-50 and AARC-10 as high as .89 for perceived age-related losses and .88 for perceived age-related gains (Table 4). A moderate negative association was observed between perceived age-related losses as measured by the AARC-10 SF and the ATOA scale. However, the ATOA scale was not significantly related to perceived age-related gains. Small but significant associations in the expected direction were found between AARC gains and losses and the relative number of years participants reported feeling older than they actually were (i.e., relative subjective age).

Higher levels of perceived age-related losses were significantly related to lower levels of well-being, such as depressive symptoms, reduced levels of overall life satisfaction, and reduced eudaimonic well-being. In many instances, reversed relationships were observed between perceived AARC gains and developmental outcomes of well-being, although the

Table 4. Correlational Evidence of Validity of the AARC-10 SF in the Early and Advanced Old Age Subsample

	AARC-10 SF		AARC-50	
Pearson's *r*, *N* = 263	Gains	Losses	Gains	Losses
Subjective aging-related constructs				
AARC-50				
Gains	.88	.14	—	—
Losses	.12	.89	—	—
Felt age	–.24	.26	–.19	.24
Attitudes toward own aging ATOA	.09 n.s.	–.54	.07 n.s.	–.54
Developmental outcomes—well-being				
Depressive symptoms	–.18	.46	–.11 n.s.	.53
Life satisfaction	.14	–.24	.17	–.28
Psychological well-being				
Autonomy	.13	–.19	.09 n.s.	–.23
Environmental mastery	.22	–.37	.14	–.47
Personal growth	.37	–.18	.33	–.25
Personal relations	.21	–.12 n.s.	.19	–.24
Purpose in life	.28	–.32	.24	–.34
Self-acceptance	.28	–.26	.26	–.36
Developmental outcomes—health				
Self-rated health	.12	–.48	.05	–.49
Functional health (SF-36)				
Physical health index	.10 n.s.	–.58	.06 n.s.	–.55
Mental health index	.14	–.22	.05 n.s.	–.33

Note: All estimates statistically significant ($p < .05$) unless otherwise indicated.

associations were substantially smaller than they were for AARC losses. However, age-related gains showed stronger associations than losses to personality-related developmental outcomes such as personal growth and personal relations, and associations comparable to losses with autonomy, self-acceptance and purpose in life. Awareness of age-related gains was not significantly related to the developmental outcomes of physical health and only weakly related to mental health and self-rated health status. For perceived losses, however, moderate associations were observed for physical health status and subjective health. Associations between perceived age-related gains and developmental outcomes in the realm of well-being and health were stronger with the SF questionnaire, whereas age-related losses showed somewhat weaker associations than the original form. The overall pattern of associations between AARC and external criterion variables, however, was very similar for both the original 50-item and the proposed 10-item versions.

Discussion and Implications

The two main objectives of the study were (a) to identify a 10-item AARC SF representing both gain- and loss-related perceptions in the behavioral domains of health and physical functioning, cognitive functioning, interpersonal relations, social-cognitive and social-emotional functioning, and lifestyle and engagement; and (b) to examine how the obtained SF would behave vis-à-vis other subjective aging measures (e.g., felt age and ATOA) as well as a range of developmental outcomes, including well-being and functional health.

Item selection was based on estimates from a GPCM that adequately reflected the multidimensionality inherent in the concept of AARC and empirical response data for the AARC-50 from a large cross-national sample of respondents covering a wide range of the adult life span (i.e., 40–98 years). We used the most discriminating items on both the gains and losses factors for the 10-item AARC SF while making sure that each behavioral subdomain was represented in the resulting instrument. The proposed AARC-10 SF showed adequate fit to the empirical data and reliability given the brevity of the measure and the coverage of distinct behavioral domains.

Comparing the performance of the AARC-10 SF across a broad segment of the adult life span, we were able to show that the SF works for the full second half of life, but that some qualifications for interpreting responses are in place, when it comes to midlife compared with early and advanced old age. The concept of perceived age-related change measured by the AARC-10 SF (i.e., the factor structure) may be considered equivalent across midlife, early-old age, and advanced old age. Nevertheless, we observed evidence for response shift across age groups, indicating that some age-related change was easier to report for early-old and advanced old respondents. Shifting item thresholds, if in line with theories about developmental processes, can add to the validation of a measure (Edwards & Wirth, 2009). From this perspective, our findings are consistent with the idea that accumulated and age-specific life experiences make it easier for the early and advanced old to endorse some of the scale items as describing commonplace and potentially inevitable phenomena in advanced age. Also, the monitoring and susceptibility for loss may significantly increase as people age. However, given that we do not have evidence from longitudinal data (e.g., from individuals who may have recently relocated or retired) to support our argument, these conclusions remain somewhat speculative at this point.

With regard to validity evidence, the AARC-10 SF showed adequate fit of the proposed response model to the empirical data and substantive associations with validity criteria. Concurrent and discriminative validity of the AARC-10 SF was evident both judged from relationships to the original form and other measures of subjective aging such as felt age and ATOA. With respect to the latter, small to moderate overlap between subjective aging concepts was observed, suggesting that the AARC-10 SF captures a distinct facet of subjective aging. However, the pattern of associations was different for age-related gains and losses. Whereas experiences of age-related gains and losses were mirrored in negative and positive relationships with felt age, attitudes held towards aging were unrelated to reported AARC gains. Obviously, negating the presumption of age-related losses inherent in most of the ATOA items does—in spite of its suggested interpretation as morale or positive attitude—not actually "extend" its scope much into a gain-oriented perspective. The pattern of associations between the AARC and validity criteria, such as well-being and health-related outcomes, was very similar for the proposed 10-item version and the original 50-item version, for which both predictive, moderating, and mediating effects on developmental outcomes were reported recently (Brothers et al., 2016; Dutt et al., 2016). The differential pattern of associations found for AARC gains and losses with environmental mastery and personal growth adds an important aspect (i.e., multi-directionality) to the discussion of the importance of subjective aging for psychological well-being and development in old age that is currently mostly informed by studies using unidimensional measures such as felt age (Ryff, 2014). Taken together, results from this MIRT-based discussion of the functioning of the AARC scale in early and advanced old age underscore previous findings that subjective aging needs to be conceptualized across different behavioral domains and that it is meaningful to distinguish between positive and negative aging-related experiences (Brothers, Miche et al., 2017).

Limitations and Future Directions

First, a combined sample of U.S. and German respondents was used without taking into account potential cultural differences in experiencing and reporting subjective aging. We have concluded elsewhere that in our data, we found more similarities than differences across cultures both

with respect to the factor structure of the AARC instrument and associations with external validity criteria (Diehl et al., 2013). Because participants in this study reported above-average levels of education, income, and health, replication in an unbiased random community sample should test whether our findings hold in the population aged 40–98 and cross-nationally. Second, the limited evidence in support of invariant scaling we found for the proposed AARC-10 SF across age groups may be a first indication of developmental change in AARC across the adult life span, but will need to be substantiated with longitudinal data. Third, although our age group categorization is in line with earlier publications about the development of the AARC instrument, staying with the classic distinction of those in midlife (40–64 years), in young-old age (65–79 years), and those in advanced old age (80+ years) would have been more in line with the general aging literature.

We envisage the short AARC version to be a useful diagnostic tool in applied fields such as the clinical and counseling area for identifying prime candidates for intervention and as an important secondary outcome in order to assess the effects of physical and cognitive training programs on specific aspects of adults' self-perceptions of aging.

We conclude that the AARC-10 SF will allow for an efficient assessment of AARC in contexts characterized by time constraints and response burden without restricting the possibilities to represent the construct in a larger context of substantive theoretical model testing. Further evidence is expected from its current implementation into a German representative study on the very old (NRW80+) as well as the National Study of Daily Events (NSDE) of the MIDUS study.

Supplementary Material

Supplementary data are available at *The Gerontologist* online.

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Conflict of Interest

None reported.

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