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ORIGINAL INVESTIGATION

Future time perspective and general self-efficacy mediate the association between awareness of age-related losses and depressive symptoms

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Abstract
Perceiving one's own aging process as associated with many losses is linked to an increase in depressive symptoms over 2.5 years. We investigated whether this pattern of associations also applies for a 4.5-year interval. No study has yet investigated the pathways underlying the association between perceived age-related losses and depressive symptoms. We examined the mediating role of future time perspective (FTP) and general self-efficacy (GSE) in this association. Analyses were based on a sample of 40-to-98-year-old adults (Time 1: 2012, $N=423$) that was assessed at two additional points covering 4.5 years (Time 2: 2015, $N=356$; Time 3: 2017, $N=299$). Perceived age-related losses were operationalized via the loss dimension of the Awareness of Age-Related Change instrument; FTP, GSE, and depressive symptoms were assessed via established questionnaires. Data were analyzed by means of a cross-lagged panel model and longitudinal mediation model realized as a structural equation model. In line with prior findings, perceived age-related losses were associated with an increase in depressive symptoms over 4.5 years. A higher amount of perceived age-related losses dampened FTP and GSE 2.5 years later, which in turn increased the level of depressive symptoms a further 2 years later, controlling for age, sex, education, physical health, and neuroticism, and taking into account the stabilities and time-synchronous correlations of the study variables. Effects were comparable across middle-aged and older individuals. FTP and GSE are important resources for understanding how perceived age-related losses translate into depressive symptoms.

Keywords Subjective aging experiences · Awareness of age-related losses · Future time perspective · General self-efficacy · Subjective well-being · Depressive symptoms

Introduction

The concept of subjective aging experiences, that is, the way people perceive and evaluate their own aging process, has recently gained increased attention (Diehl et al. 2014). A rather novel construct in this context is the construct of *awareness of age-related change* (AARC). 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 […]" (Diehl and Wahl 2010). AARC captures perceived age-related gains (AARC-Gains) and losses (AARC-Losses) across different behavioral domains. The multidirectional and multidimensional character anchors the AARC construct in established life-span developmental psychology principles (Baltes et al. 2006) and distinguishes it from other subjective aging operationalizations, such as felt age (Diehl et al. 2014).

In prior research, AARC has been linked to depressive symptoms (Dutt et al. 2016). Depressive symptoms comprise sadness or absence of happiness and optimism (Radloff 1977). They naturally operate on the basis of a continuum from no-to-severe symptoms (Bowins 2015). In a similar vein, Siddaway et al. (2017) found that depressive symptoms constitute a single factor with a well-being/depression continuum.

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More specifically, higher AARC-Losses were associated with an increase in depressive symptoms over 2.5 years (Dutt et al. 2016). Yet, it remains unclear whether this association unfolds over longer time frames and through which mechanisms AARC-Losses translate into depressive symptoms (i.e., mediators). Depressive symptoms reveal considerable frequency in middle and late adulthood (Luppa et al. 2012) and exert adverse effects on health (Ho et al. 2014) and mortality (Gallo et al. 2005). Given this key role of depressive symptoms in developmental psychology, we argue that additional research is needed to shed light on (pathways in) the AARC-Losses–depressive symptoms association. Drawing upon the work of Dutt et al. (2016), a first aim was to replicate the finding that AARC-Losses are associated with depressive symptoms in middle and old adulthood, relying on a 4.5-year interval. A second aim was to examine the role of mediators in this association.

Fundamental longitudinal associations between awareness of age-related losses and depressive symptoms

Theoretical considerations suggest bidirectional associations between AARC-Losses and depressive symptoms based on behavioral, cognitive, or motivational pathways. A detailed description of these mechanisms can be found in Dutt et al. (2016). For example, the perception of many age-related losses may be associated with less adaptive coping efforts which in turn should increase depressive symptoms (Wurm et al. 2013). Conversely, the negative developmental changes that are elicited by depressive symptoms (e.g., cognition; Bunce et al. 2014) may be misattributed to increasing age, such that AARC might be tainted by depressive symptoms. Both directions of effect can also be explained by mechanisms of selective attention and interpretation due to a desire for a consistent self-view (Swann 1983). Due to the deep incorporation of AARC into a person's self-concept (Diehl et al. 2015), and in line with Dutt et al. (2016), we assumed that the effect of AARC-Losses on depressive symptoms is stronger than the converse. In a next step, we examined specific mediators in the AARC-Losses–depressive symptoms association.

Selected mediators in the association between awareness of age-related losses and depressive symptoms

In her *stereotype embodiment theory*, Levy (2009) proposes several pathways via which subjective aging experiences translate into developmental outcomes. Precisely, Levy suggests that subjective aging experiences exert an effect on well-being through psychological, behavioral, or physiological pathways. Given the specific nature of our data (i.e., questionnaire data), we decided to focus on psychological pathways in this work.

The AARC construct implies that perceived behavioral changes are attributed to increasing age (Diehl and Wahl 2010). Two considerations can be derived. First, AARC comprises temporal comparison processes, where past and ongoing experiences are integrated. It seems worthwhile to investigate how temporal comparison processes revolving around past experiences extend to the anticipation of future events. We therefore chose future time perspective (FTP) as a mediator in the AARC-Losses–depressive symptoms association. Second, AARC is deeply rooted in daily behavior, performance, and experiences. It seems necessary to examine how such age-related constraints in everyday life influence an individual's expectations to efficiently deal with daily hassles. We therefore chose general self-efficacy (GSE) as a second mediator in the AARC-Losses–depressive symptoms association.

There is already evidence on a mediating role of FTP and GSE in the subjective aging–well-being association (Brothers et al. 2016; Stephan et al. 2011). These studies focused on life satisfaction and eudaimonic well-being; it remains unclear whether findings also apply to depressive symptoms. Moreover, previous studies were in part cross-sectional, thus prohibiting causal conclusions.

Future time perspective as a mediator in the association between awareness of age-related losses and depressive symptoms FTP captures an individual's perception of his or her remaining lifetime. With growing age, an individual perceives future time as being increasingly limited (Lang and Carstensen 2002).

We assumed a mediating role of FTP in the AARC-Losses–depressive symptoms association. First, AARC-Losses should impact FTP. Perceiving negative age-related changes might remind of being in the last phase of life and hence should narrow FTP (Brothers et al. 2016). Indeed, higher AARC-Losses are associated with a limited FTP (Brothers et al. 2016). This association also applies for other subjective aging measures. Older adults who psychologically dissociated themselves from their age group perceived their future as more open-ended (Weiss and Lang 2012).

Second, FTP should be related to depressive symptoms. A more limited FTP is associated with higher depressive symptoms (Hoppmann et al. 2017). This association might be explained by behavioral pathways, such as lower use of adaptive coping (Baltes et al. 2014), less positive social exchanges (Windsor et al. 2011), and less health behaviors (Stahl and Patrick 2012).

In the light of these findings, we assumed that high levels of perceived age-related losses narrow FTP, which in turn should increase the level of depressive symptoms.

General self-efficacy as a mediator in the association between awareness of age-related losses and depressive symptoms GSE (Bandura 1977) captures the belief in one's competence to tackle difficult or novel tasks and to cope with adversity in challenging situations (Luszczynska et al. 2005). GSE tends to decline from age 50 or 60 on (Schieman and Campbell 2001).

We assumed a mediating role of GSE in the AARC-Losses–depressive symptoms association. First, AARC-Losses should impact GSE. Perceiving loss experiences across different behavioral domains and attributing them to age, that is, to an internal factor, can be understood as absence of mastery experiences and thus should dampen self-efficacy (Bandura 1977). The association between subjective aging experiences and GSE has also been shown empirically. People who feel younger than their age are more likely to experience high GSE (Teuscher 2009).

Second, GSE is related to depressive symptoms (Steunenberg et al. 2006). This association can be explained by higher well-being-enhancing behaviors (e.g., health behaviors, adaptive coping) in individuals with high self-efficacy beliefs (Bandura 1977; Jang et al. 2002).

Based on these considerations, we assumed that high levels of perceived age-related losses dampen GSE, which in turn should increase the level of depressive symptoms.

Research aims and hypotheses

This study examined the association between AARC-Losses and change in depressive symptoms in middle-aged and older adults using three measurement points covering 4.5 years. First, extending Dutt et al.'s (2016) finding, we assumed that the effect of AARC-Losses on change in depressive symptoms over 4.5 years is stronger than the reverse direction (Hypothesis 1). Second, we expected that the detrimental effect of AARC-Losses on change in depressive symptoms over 4.5 years is mediated by FTP and GSE (Hypothesis 2). Theoretical considerations suggest changes in the normativity of age-related experiences across the life span, with older adults having a higher likelihood of experiencing losses (Baltes et al. 1980). Therefore, we also exploratorily tested for age effects by contrasting the hypothesized pattern of associations between middle-aged (< 65 years) and old-aged (≥ 65 years) adults.

Method

Study design and participants

Data were collected in 2012 (T1), 2015 (T2), and 2017 (T3). Ethical approval for T3 was obtained from the research ethics committee of the Faculty of Behavioral and Cultural Studies at Heidelberg University. The observational interval covered on average 2.56 years (SD = 13.18 days) between T1 and T2 and 4.67 years (SD = 13.63 days) between T1 and T3.

In total, 423 persons participated at T1, 356 persons participated at T2 (84%), and 299 persons participated at T3 (71%). Main reasons for dropout from T1 to T2 were no interest (34%), health problems (9%), or death (6%). Main reasons for dropout from T1 to T3 were no interest (55%), health problems (7%), or death (10%). Regarding the T2 measurement, dropouts were older than participants, $d = 0.49$, and reported a worse physical health, $d = -0.25$. Regarding the T3 measurement, dropouts were more common among men than among women. Dropouts were older than participants, $d = 0.41$. Participants and dropouts for T2 and T3, respectively, did not differ on the remaining study variables at T1, all $ps > .05$. Thus, analyses were based on the 423 T1 participants. Missing data were replaced using the expectation–maximization (EM) algorithm, such that the final sample size amounted to $N = 423$. The EM algorithm provides robust estimates in the reconstruction of the missing sample data (Gold and Bentler 2000).

At T1, participants were between 40 and 98 years old ($M = 62.94$, SD = 11.84 years). Two-thirds were women (64%). 61% were partnered or married. Education was high, with an average of 11.53 years (SD = 1.96 years) of schooling, and with more than half of the participants (55%) having a general qualification for university entrance. 40% were retired. 84% reported an average or above-average subjective health. Descriptive information of the study variables is summarized in Table 1.

Measures

Predictor: awareness of age-related losses AARC-Losses were measured with the 25-item loss-related subscale of the AARC questionnaire (Brothers et al. 2018). Each item is preceded by the item stem "With my increasing age, I realize that…" and comprises the description of a negative experience in one out of five behavioral domains, that is, health and physical functioning, cognitive functioning, interpersonal relations, social-cognitive/social-emotional functioning, and lifestyle and engagement. The 25 items evenly represent the five behavioral domains. An example for a negative aging experience is "…that it is more difficult for me to learn new things." Participants indicated their agreement on a 5-point Likert scale, from 1 (*not at all*) to 5 (*very much*). The internal consistency for the scale was good (Cronbach's $\alpha = .92$ at T1 and .93 at T3). For latent modeling, we parceled the indicator variables (Little et al. 2002). The five domain mean scores served as indicators for the AARC-Losses factor. We calculated a composite reliability index as an indicator of the internal consistency of

Table 1 Descriptive information and bivariate associations between the study constructs, assessed at T1 (2012), T2 (2015), and T3 (2017)

	M (SD)	1	2	3	4	5	6	7	8	9
1. T1 AARC-Losses	2.23 (0.61)	–								
2. T3 AARC-Losses	2.18 (0.61)	.74***	–							
3. T1 depressive symptoms	1.76 (0.51)	.57***	.51***	–						
4. T3 depressive symptoms	1.81 (0.50)	.51***	.60***	.60***	–					
5. T1 future time perspective	3.45 (1.17)	−.52***	−.47***	−.37***	−.40***	–				
6. T2 future time perspective	3.46 (1.10)	−.51***	−.49***	−.30***	−.39***	.73***	–			
7. T3 future time perspective	3.37 (0.99)	−.50***	−.48***	−.31***	−.40***	.74***	.76***	–		
8. T2 general self-efficacy[a]	2.93 (0.45)	−.35***	−.37***	−.35***	−.37***	.39***	.48***	.38***	–	
9. T3 general self-efficacy[a]	2.87 (0.44)	−.29***	−.38***	−.39***	−.41***	.40***	.42***	.36***	.76***	–

All parameters reported have been adjusted by the expectation–maximization (EM) estimate

M mean, *SD* standard deviation

[a]General self-efficacy has not been assessed at T1

$N = 423$. ***$p < .001$

the scale (Raykov 1997), which is estimated based on the parcel factor loadings. This composite reliability amounted to .86 at T1 and .89 at T3.

Outcome: depressive symptoms The Center for Epidemiologic Studies Depression Scale (CES-D; Radloff 1977) measures an individual's current level of depressive symptoms. The CES-D does not assess clinical symptoms of depression, but constitutes a well-being/depression continuum (Siddaway et al. 2017). The 10-item version used here shows good psychometric properties in old adults (Irwin et al. 1999). The items were evaluated on the basis of the symptoms during the past week and judged on a 4-point Likert scale, from 1 (*rarely or none of the time*) to 4 (*most or all of the time*). The internal consistency was good (Cronbach's $\alpha = .85$ at T1 and .86 at T3). For latent modeling, items were parceled into three parcels comprising 3–4 items, with an equal distribution of factor loadings across parcels. The composite reliability amounted to .86 at T1 and T3.

Mediator: future time perspective FTP was operationalized by a 10-item scale developed by Carstensen and Lang (1996). An example for an item formulation is "My future seems infinite to me." The items were evaluated on a 7-point Likert scale, from 1 (*very untrue*) to 7 (*very true*). The scale yielded a good internal consistency (Cronbach's $\alpha = .89$ at T1 and T2 and .86 at T3). For latent modeling, items were parceled into three parcels comprising 3–4 items with an equal distribution of factor loadings. The composite reliability amounted to .91 at T1, .90 at T2, and .88 at T3.

Mediator: general self-efficacy GSE was assessed using the General Self-Efficacy Scale by Schwarzer and Jerusalem (1995). Ten items assess a person's confidence to overcome difficult situations due to his or her own competence, for example "I am confident that I could deal efficiently with unexpected events." Each statement was judged on a 4-point Likert scale, from 1 (*not at all true*) to 4 (*exactly true*). The internal consistency was good (Cronbach's $\alpha = .91$ at T2 and T3; GSE was not assessed at T1). For latent modeling, items were parceled into three parcels comprising 3–4 items with an equal distribution of item factor loadings. The composite reliability amounted to .91 at T2 and .92 at T3.

Control variables T1 calendar age, sex, education, physical health, and neuroticism were used as manifest control variables, as has been done in Dutt et al. (2016). Sex was coded as 0 (*male*) and 1 (*female*). Education was operationalized as years of schooling. Physical health was operationalized as the SF-36 physical health component summary score, which comprises eight subscales (Bullinger et al. 1995). Cronbach's α ranged between .76 and .93 for the eight SF-36 subscales. Neuroticism was assessed by the NEO five-factor inventory (Borkenau and Ostendorf 2008). The items were rated on a 5-point Likert scale, ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The neuroticism subscale showed a good internal consistency (Cronbach's $\alpha = .84$).

Data analyses

Hypothesis 1 To test our first hypothesis, that is, AARC-Losses exert an effect on change in depressive symptoms, we specified a latent cross-lagged panel model realized with AMOS 24. The structural model included four latent variables, that is, AARC-Losses and depressive symptoms, both assessed at T1 and T3 (Fig. 1). The control variables were correlated with T1 AARC-Losses and T1 depressive symptoms. We first specified a model with the autoregressive paths only. This model was compared in terms of χ^2 to

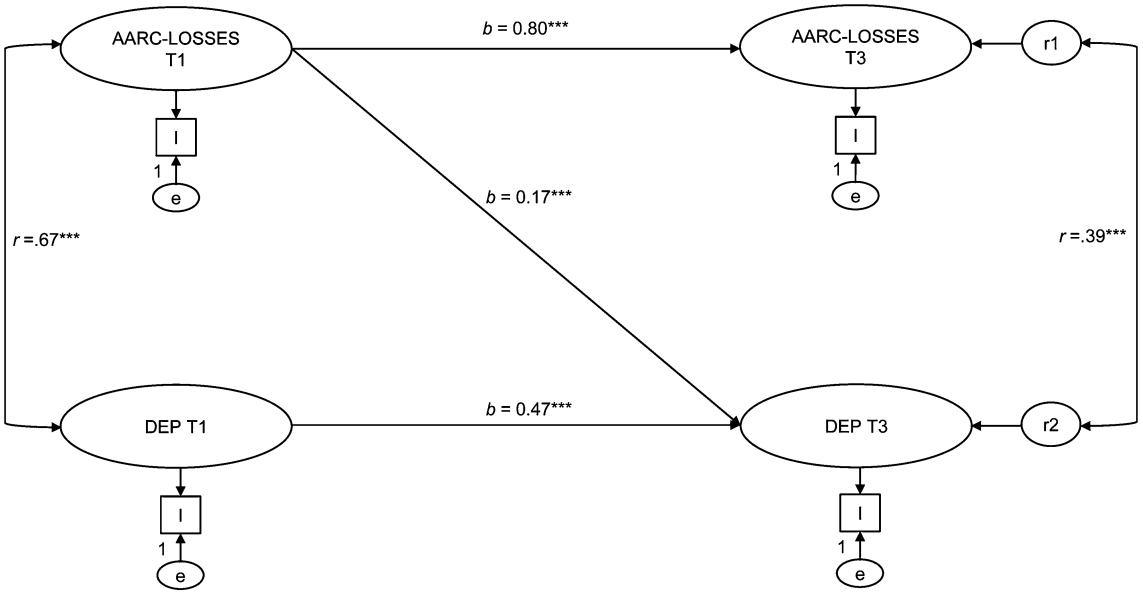

Fig. 1 Structural equation model examining associations between Time 1 (T1, 2012) and Time 3 (T3, 2015) awareness of age-related losses (AARC-Losses) and depressive symptoms (DEP). *Notes. e* manifest variable residual; *I* manifest indicators modeled as item parcels; *r* latent variable residual. The analyses controlled for T1 age, sex, education, physical health, and neuroticism. Residual paths are constrained to 1. All parameters reported have been adjusted by the expectation–maximization (EM) estimate. $N = 423$. ***$p < .001$

a model including the autoregressive paths and all cross-lagged paths (full model). Cross-lagged path coefficients that turned out to be nonsignificant in the full model were restricted to 0, and change in χ^2 was evaluated.

Hypothesis 2 To test our hypothesis on a mediating role of FTP and GSE in the AARC-Losses–depressive symptoms association, we specified a latent longitudinal mediation model. As mediation consists of causal processes that unfold over time, longitudinal mediation models account for the temporal structure that is required to test mediation, thus constituting a clear advantage over cross-sectional mediation models (Maxwell and Cole 2007). The structural model resembled the model tested within the context of Hypothesis 1, but was extended by the two mediators. In order to account for time-synchronous associations between the mediators and the predictor and the outcome, respectively, assessments of the mediators were included for the three measurement points (except for T1 GSE, as GSE had only been measured at T2 and T3). The model thus also takes into consideration the stability of the study variables across the observational interval (Cole and Maxwell 2003). Paths were specified from T1 AARC-Losses to T3 depressive symptoms, from T1 AARC-Losses to T2 FTP and GSE, and from T2 FTP and GSE to T3 depressive symptoms (mediation model in its narrower sense). We specified a covariance between the residuals of T2 FTP and GSE (Luszczynska et al. 2005) (Fig. 2). Again, the control variables were correlated with all T1 variables.

To test the mediating role of FTP and GSE for the AARC-Losses–depressive symptoms association, the significance of the indirect effect was assessed using 95% bias-corrected bootstrapped confidence intervals (BCCI) based on 5000 bootstrap samples (Preacher and Hayes 2008). We report κ^2 as an effect size measure (Preacher and Kelley 2011). κ^2 can be interpreted as the proportion of the maximum possible indirect effect that could have occurred (range 0–1). We also report the partially standardized indirect effect ab_{ps}, that is, the ratio of the indirect effect to the standard deviation of the outcome (Preacher and Kelley 2011). ab_{ps} indicates by how many standard deviations the outcome changes for every one-unit increase in the predictor indirectly via the mediator.

Results

Bivariate correlations between the study constructs are displayed in Table 1. T1 AARC-Losses were positively linked to depressive symptoms within and across measurements. AARC-Losses and depressive symptoms were negatively linked to FTP and GSE within and across measurements.

Measurement invariance

Measurement invariance across time As AARC-Losses, depressive symptoms, FTP, and GSE were assessed at different occasions, we tested for temporal measurement invariance (MI) by specifying progressively stricter measurement

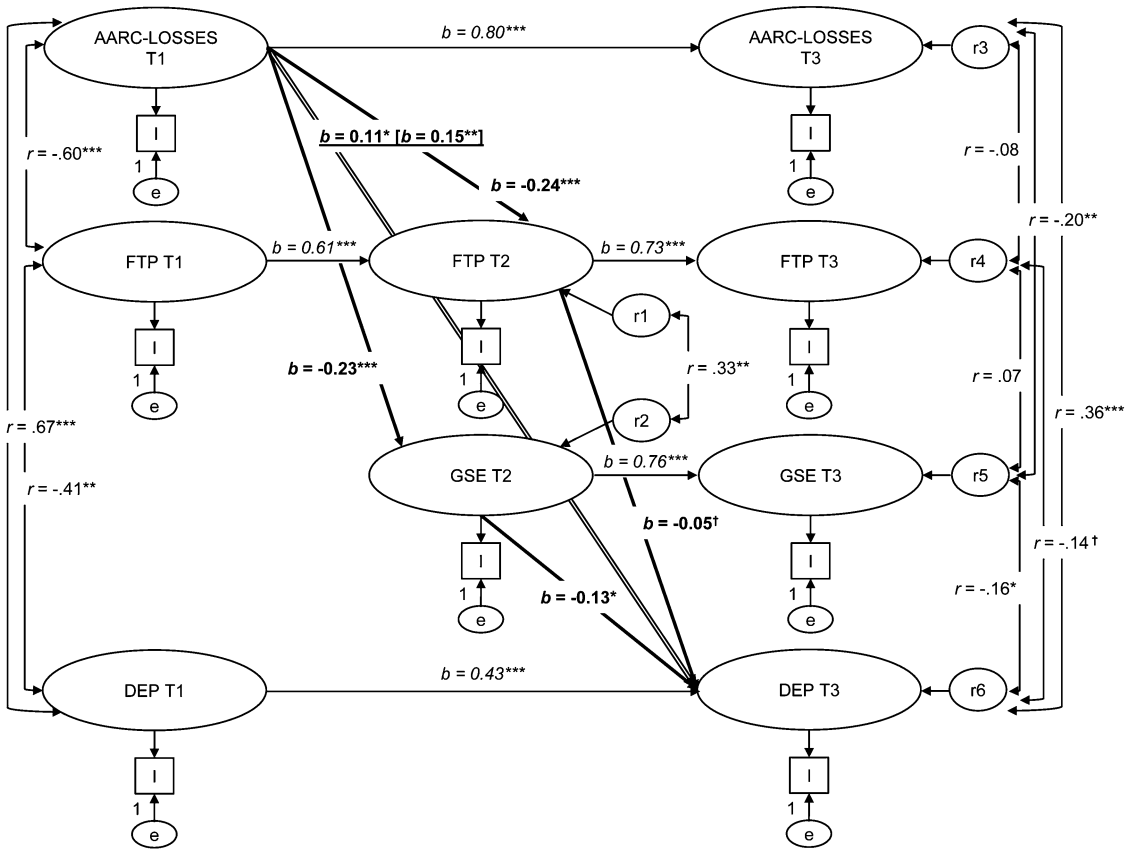

Fig. 2 Structural equation model examining the mediation of Time 1 (T1, 2012) awareness of age-related losses (AARC-Losses) on Time 3 (T3, 2017) depressive symptoms (DEP) via Time 2 (T2, 2015) future time perspective (FTP) and T2 general self-efficacy (GSE). *Notes. e* manifest variable residual; *I* manifest indicators modeled as item parcels; *r* latent variable residual. The analyses controlled for T1 age, sex, education, physical health, and neuroticism. Residual paths are constrained to 1. Autoregressive path coefficients are printed in italics. Path coefficients of the mediation model in its narrowest sense are printed in bold. The total effect is reported in brackets. All parameters reported have been adjusted by the expectation–maximization (EM) estimate. $N = 423$. $^{\dagger}p < .10$, $*p < .05$, $**p < .01$, $***p < .001$

models (Horn and McArdle 1992). For all constructs, modification indices suggested a correlation between corresponding errors across measurements (e.g., T1 depressive symptoms parcel 1 error with T3 depressive symptoms parcel 1 error) that we admitted. Following the recommendations of Cheung and Rensvold (2002), a decrease by > .01 in the comparative fit index (CFI) after imposing restrictions to the model was interpreted as a violation of MI. As we did not estimate parcel intercepts within the models, weak MI (i.e., equal factor loadings across measurements) is sufficient to proceed with the main hypothesis testing. Using the criterion by Cheung and Rensvold (2002), weak MI could be established for all study constructs.

Measurement invariance across age groups In order to investigate age effects between middle-aged (< 65 years; $N = 255$) and older (≥ 65 years; $N = 168$) adults, we tested for MI across age groups. We chose age 65 as cutoff for the age groups, as this age is tied to legislative regulations in Germany, such as entry into retirement, thus separating two life phases. Participants in the old-age group were older, $d = 2.69$, reported worse physical health, $d = -0.38$, more AARC-Losses, T1: $d = 0.47$; T3: $d = 0.51$, and a more limited FTP, T1: $d = -0.88$, T2: $d = -0.69$, T3: $d = -0.66$, as compared to participants in the middle-age group. Men were more strongly represented in the old-age group as compared to the middle-age group. Using ΔCFI as a criterion, weak MI could be established across age groups for all study variables.

Hypothesis 1: findings of a cross-lagged panel model linking AARC-Losses with depressive symptoms over 4.5 years

The model containing all cross-lagged paths fit the data better than the model containing the autoregressive paths only, $\Delta\chi^2(2) = 18.04$, $p < .001$. A closer inspection of the cross-lagged path coefficients revealed that the path from T1

depressive symptoms to T3 AARC-Losses was not significant, $p = .188$. Restraining this path to 0 did not significantly weaken the model fit, $\Delta\chi^2(1) = 1.67$, $p = .196$. The reduced model yielded acceptable fit, $\chi^2(162) = 584.24$, CFI = .927, root mean square error of approximation (RMSEA) = .079, 90% confidence interval (CI) [.072, .086]. The effect of T1 AARC-Losses on T3 depressive symptoms was significant, $b = 0.17$, standard error (SE) = 0.04, $p < .001$. The effect size, calculated as z-value (b/SE) relative to the root of the sample size (Rosenthal 1994), amounted to $r = .21$, indicating a small effect. Hence, higher T1 AARC-Losses were associated with an increase in depressive symptoms over 4.5 years, whereas the reverse direction of effects was not significant (Fig. 1). The result thus extends the findings from Dutt et al. (2016) to a 4.5-year interval.

We tested for differences between middle-aged and older adults. Based on the assumption of weak MI across age groups, we imposed equality constraints on the cross-lagged and autoregressive paths across age groups within the full model. Compared with the unconstrained model, there was no significant worsening of model fit, $\Delta\chi^2(4) = 6.27$, $p = 0.180$. Hence, it can be assumed that the effects were equivalent across age groups.

Hypothesis 2: findings of a longitudinal mediation model targeting future time perspective and general self-efficacy

The longitudinal mediation model yielded a satisfactory fit, $\chi^2(541) = 1542.27$, CFI = .918, RMSEA = .066, 90% CI [.062, .070]. The model explained 46.2% of variance in depressive symptoms (Fig. 2). The direct effect of T1 AARC-Losses on T2 FTP was significant, $b = -0.24$, $SE = 0.06$, $p < .001$, as was the direct effect of T1 AARC-Losses on T2 GSE, $b = -0.23$, $SE = 0.03$, $p < .001$. T2 FTP and GSE, in turn, exerted a (marginally) significant direct effect on T3 depressive symptoms, $b = -0.05$, $SE = 0.03$, $p = .056$ for FTP; $b = -0.13$, $SE = 0.05$, $p = .011$ for GSE. Hence, the perception of one's aging as associated with many losses leads to a reduction in perceived future time and general self-efficacy 2.5 years later, which in turn intensified depressive symptoms a further 2 years later, controlling for age, sex, education, physical health, and neuroticism, and taking into account the autoregressive effects of the study variables over time as well as their time-synchronous correlations.

The total effect of T1 AARC-Losses on T3 depressive symptoms was significant, $b = 0.15$, $SE = 0.05$, $p = .002$. When the mediators were included, the direct effect of T1 AARC-Losses on T3 depressive symptoms was attenuated, $b = 0.11$, $SE = 0.05$, $p = .024$. The total indirect effect of T1 AARC-Losses on T3 depressive symptoms through the two mediators amounted to significance, $b = 0.04$, $SE = 0.02$, 95% BCCI [0.02, 0.08], $p < .001$. This suggests that the effect of AARC-Losses on depressive symptoms was mediated via FTP and GSE. The complete indirect effect can be divided into components attributable to the mediational effect of FTP and GSE, respectively. The two specific indirect effects amounted to significance each, with $b = 0.01$, $SE = 0.01$, 95% BCCI [0.00, 0.03], $p = .018$, $ab_{ps} = 0.02$, $\kappa^2 = .02$, for FTP, and $b = 0.04$, $SE = 0.01$, 95% BCCI [0.01, 0.07], $p = .001$, $ab_{ps} = 0.07$, $\kappa^2 = .06$, for GSE. The difference between the two specific indirect effects was not significant, $p = .589$.

We next examined the specific indirect effects separately for each mediator within two single mediator models, with the other mediator removed from the model. The indirect effect through FTP amounted to significance, $b = 0.02$, $SE = 0.01$, 95% BCCI [0.00, 0.04], $\beta = .11$, $p = .003$, $ab_{ps} = 0.03$, $\kappa^2 = .02$. Regarding GSE as a mediator, the indirect effect was significant, too, $b = 0.04$, $SE = 0.01$, 95% BCCI [0.01, 0.07], $\beta = .05$, $p = .002$, $ab_{ps} = 0.07$, $\kappa^2 = .06$. Hence, FTP and GSE, considered both in combination as well as alone, can be viewed as significant mediators in the AARC-Losses–depressive symptoms association.

We tested for differences between middle-aged and older adults. Based on the assumption of weak MI across age groups, we imposed equality constraints on the structural paths across age groups. Compared with the unconstrained model, there was no significant worsening of model fit, $\Delta\chi^2(10) = 17.63$, $p = .062$. Hence, it can be assumed that the effects were equivalent across age groups.

Discussion

We were able to replicate the finding on an effect of AARC-Losses on change in depressive symptoms, controlling for T1 depressive symptoms, in middle- and old-aged adults that has been obtained by Dutt et al. (2016). An extension of this study was the inclusion of a 4.5-year interval. We next examined FTP and GSE as mediators in the AARC-Losses–depressive symptoms association. Many perceived losses dampened FTP and GSE 2.5 years later, which in turn increased depressive symptoms a further 2 years later. Effects were robust after controlling for age, sex, education, physical health, and neuroticism, and taking into account the stabilities and time-synchronous correlations of the study variables. Effects were comparable in middle- and old-aged adults.

Awareness of age-related losses is associated with change in depressive symptoms

In line with Dutt et al. (2016), many perceived age-related losses were associated with an increase in depressive symptoms over 4.5 years, whereas the reverse direction of effect

did not reach significance. The independence of AARC-Losses from depressive symptoms points to the robustness of AARC and suggests that AARC might be deeply incorporated into a person's self-concept (Diehl et al. 2015), thus providing little target for depressive symptoms.

Levy (2009) assumes within her *stereotype embodiment theory* that the effect of subjective aging experiences on well-being may be mediated through psychological, behavioral, and physiological mechanisms. We focused on the psychological pathway in this work and examined FTP and GSE as mediators in the AARC-Losses–depressive symptoms association. By drawing on three measurement points, we were able to address the chronological sequence of AARC-Losses, FTP, GSE, and depressive symptoms.

Future time perspective and general self-efficacy mediate the association between awareness of age-related losses and depressive symptoms

The mediating role of FTP and GSE in the AARC-Losses–depressive symptoms association can be illustrated exemplarily with regard to age-related loss experiences in the physical domain (i.e., increased bodily pain). Such an experience is particularly detrimental as the perceived losses are attributed to age, that is, to an internal and irreversible condition (Diehl and Wahl 2010). An individual who is aware of negative physical changes might interpret them as a sign of the aging process constantly moving ahead. In the light of this immediate confrontation with one's life finitude, his or her FTP is dampened (Brothers et al. 2016). Moreover, a person who encounters many physical declines accompanied by constraints in everyday life might start questioning his or her competence to efficiently deal with daily hassles, attenuating GSE (Bandura 1977). The reduced FTP and GSE should turn the individual into a state of avoidance, refraining from health behaviors (e.g., Stahl and Patrick 2012), social contacts (e.g., Windsor et al. 2011), or adaptive coping (e.g., Baltes et al. 2014). At the end of the day, the individual will undergo an increase in depressive symptoms.

We exclusively focused on the loss component of AARC. This decision was driven by the observation that AARC-Losses were associated with depressive symptoms, whereas AARC-Gains were unrelated to depressive symptoms in prior research (Dutt et al. 2016). This is in line with Baumeister et al.'s (2001) general observation that negative events exert a stronger impact on developmental outcomes as compared to positive events (see also Meisner 2012). We exploratorily repeated our analyses with AARC-Gains. The total effect of AARC-Gains on depressive symptoms was not significant over the 4.5-year interval, $b = 0.03$, $SE = 0.04$, $p = .505$. Moreover, the indirect effect through FTP and GSE did not reach significance, $b = -0.01$, $SE = 0.02$, 95% BCCI [−0.04, 0.02], $\beta = -.02$, $p = .684$. Hence, the mediating role of FTP and GSE that we found in the AARC-Losses–depressive symptoms association cannot be generalized to AARC-Gains.

We did not find any age effects regarding the patterns of association. It has to be taken into account that our sample included few very old adults (only 11.1% were 80 years and older at T1). The inclusion of more adults in advanced old age might have increased the probability of finding age effects.

At the practical level, our results can contribute to the prevention and treatment of depressive disorders in the second half of life. Although the treatment of depressive symptoms requires interdisciplinary therapeutic approaches, a better understanding of the mechanisms underlying the harmful association between perceived age-related losses and depressive symptoms could provide a starting point for the development of interventions to overcome this detrimental relationship. When one is sensitive to, for example, the potentially hazardous effect of high AARC-Losses on GSE, a therapeutic goal could be to purposefully provide the aging individual with experiences of mastery to maintain high levels of GSE despite many perceived losses. Similarly, the detrimental association between AARC-Losses and FTP can be attenuated by redirecting older adults' view of the future from a focus on limitations to a focus on opportunities (Cate and John 2007) (e.g., via increasing the awareness of gain experiences or via a reformulation of long-term goals to short-term goals that can be attained in the near future). Future studies are needed to tailor such intervention programs.

Limitations and future research

The sample was positively biased with regard to education or health. As such, caution is advisable when generalizing the results to other populations.

Although we controlled for T1 depressive symptoms and FTP, thus depicting change over 4.5 years, GSE was only assessed at T2 and T3. Future investigations should examine how AARC-Losses predict change in GSE.

All effects were of small effect size. However, given the high practical significance of depressive symptoms, also effects of a small size merit the attention to be investigated (Roberts et al. 2007).

By choosing FTP and GSE as mediators, we took into consideration two psychological mechanisms as postulated by *stereotype embodiment theory* (Levy 2009). Notwithstanding, other constructs, for example, coping, health (behaviors), physiological or physical activity, are also conceivable as mediators and should be investigated in future research (see also Stephan et al. 2011).

Theoretical considerations suggest that individual dispositions may amplify or buffer the effect of subjective aging

experiences on depressive symptoms (Dutt et al. 2018; Wurm and Benyamini 2014), such that FTP and GSE could also function as a moderator in the AARC-Losses–depressive symptoms association. In additional analyses, however, the interaction between T1 AARC-Losses and FTP in the prediction of change in depressive symptoms did not reach significance. As GSE was not assessed at T1, we were not able to also test such a moderator hypothesis for GSE. This should be on the agenda for future research.

In conclusion, we found that the harmful effect of many perceived age-related losses on depressive symptoms over 4.5 years was mediated by FTP and GSE, controlling for demographic variables, physical health, and neuroticism. Our results suggest that the translation of subjective aging experiences into developmental outcomes is a complex and multistage phenomenon.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

References

Baltes P, Reese HW, Lipsitt LP (1980) Life-span developmental psychology. Ann Rev Psychol 31:65–110. https://doi.org/10.1146/annurev.ps.31.020180.000433

Baltes P, Lindenberger U, Staudinger UM (2006) Life span theory in developmental psychology. 6 edn. In: Damon W, Lerner RM (eds) Handbook of child psychology: theoretical models of human development, vol 1. Wiley, Hoboken, pp 569–664

Baltes B, Wynne K, Sirabian M, Krenn D, De Lange A (2014) Future time perspective, regulatory focus, and selection, optimization, and compensation: testing a longitudinal model. J Organ Behav 35:1120–1133. https://doi.org/10.1002/job.1970

Bandura A (1977) Self-efficacy: toward a unifying theory of behavioral change. Psychol Rev 84:191–215. https://doi.org/10.1037/0033-295X.84.2.191

Baumeister RF, Bratslavsky E, Finkenauer C, Vohs KD (2001) Bad is stronger than good. Rev Gen Psychol 5:323–370. https://doi.org/10.1037/1089-2680.5.4.323

Borkenau P, Ostendorf F (2008) NEO Fünf-Faktoren Inventar (NEO-FFI); nach Costa und McCrae [NEO Five-Factor Inventory (NEO-FFI); by Costa and McCrae]. Hogrefe, Göttingen

Bowins B (2015) Depression: discrete or continuous? Psychopathology 48:69–78. https://doi.org/10.1159/000366504

Brothers A, Gabrian M, Wahl H-W, Diehl M (2016) Future time perspective and awareness of age-related change: examining their role in predicting psychological well-being. Psychol Aging 31:605–617. https://doi.org/10.1037/pag0000101

Brothers A, Gabrian M, Wahl H-W, Diehl M (2018) A new multidimensional questionnaire to assess awareness of age-related change (AARC). Gerontol. https://doi.org/10.1093/geront/gny006

Bullinger M, Kirchberger I, Ware J (1995) Der deutsche SF-36 Health Survey: Übersetzung und psychometrische Testung eines krankheitsübergreifenden Instruments zur Erfassung der gesundheitsbezogenen Lebensqualität [The German SF-36 health survey: Translation and psychometric testing of a generic instrument for the assessment of health-related quality of life] Zeitschrift für Gesundheitswissenschaften 3:21–36

Bunce D, Batterham PJ, Christensen H, Mackinnon AJ (2014) Causal associations between depression symptoms and cognition in a community-based cohort of older adults. Am J Geriatr Psychiatry 22:1583–1591. https://doi.org/10.1016/j.jagp.2014.01.004

Carstensen LL, Lang FR (1996) Future time perspective scale. Unpublished manuscript, Stanford University

Cate RA, John OP (2007) Testing models of the structure and development of future time perspective: maintaining a focus on opportunities in middle age. Psychol Aging 22:186–201. https://doi.org/10.1037/0882-7974.22.1.186

Cheung GW, Rensvold RB (2002) Evaluating goodness-of-fit indexes for testing measurement invariance. Struct Equ Model 9:233–255. https://doi.org/10.1207/S15328007SEM0902_5

Cole DA, Maxwell SE (2003) Testing mediational models with longitudinal data: questions and tips in the use of structural equation modeling. J Abnorm Psychol 112:558–577. https://doi.org/10.1037/0021-843X.112.4.558

Diehl M, Wahl H-W (2010) Awareness of age-related change: examination of a (mostly) unexplored concept. J Gerontol Ser B Psychol Sci Social Sci 65B:340–350. https://doi.org/10.1093/geronb/gbp110

Diehl M et al (2014) Awareness of aging: theoretical considerations on an emerging concept. Dev Rev 34:93–113. https://doi.org/10.1016/j.dr.2014.01.001

Diehl M, Wahl H-W, Brothers A, Miche M (2015) Subjective aging and awareness of aging: toward a new understanding of the aging self. In: Diehl M, Wahl H-W (eds) Annual review of gerontology and geriatrics: subjective aging: new developments and future directions, vol 35. Springer, New York, pp 1–28

Dutt AJ, Gabrian M, Wahl H-W (2016) Awareness of age-related change and depressive symptoms in middle and late adulthood: Longitudinal associations and the role of self-regulation and calendar age. J Gerontol Ser B Psychol Sci Social Sci. https://doi.org/10.1093/geronb/gbw095

Dutt AJ, Wahl HW, Rupprecht FS (2018) Mindful vs. mind full: processing strategies moderate the association between subjective aging experiences and depressive symptoms. Psychol Aging. https://doi.org/10.1037/pag0000245

Gallo JJ, Bogner HR, Morales KH, Post EP, Have TT, Bruce ML (2005) Depression, cardiovascular disease, diabetes, and two-year mortality among older, primary-care patients. Am J Geriatr Psychiatry 13:748–755. https://doi.org/10.1176/appi.ajgp.13.9.748

Gold MS, Bentler PM (2000) Treatments of missing data: a Monte Carlo comparison of RBHDI, iterative stochastic regression imputation, and expectation-maximization. Struct Equ Model 7:319–355. https://doi.org/10.1207/S15328007SEM0703_1

Ho CSH, Feng L, Fam J, Mahendran R, Kua EH, Ng TP (2014) Coexisting medical comorbidity and depression: multiplicative effects on health outcomes in older adults. Int Psychogeriatr 26:1221–1229. https://doi.org/10.1017/S1041610214000611

Hoppmann CA, Infurna FJ, Ram N, Gerstorf D (2017) Associations among individuals' perceptions of future time, individual resources, and subjective well-being in old age. J Gerontol Ser B Psychol Sci Social Sci 72B:388–399. https://doi.org/10.1093/geronb/gbv063

Horn JL, McArdle JJ (1992) A practical and theoretical guide to measurement invariance in aging research. Exp Aging Res 18:117–144

Irwin MR, Artin KH, Oxman MN (1999) Screening for depression in the older adult: criterion validity of the 10-item Center for Epidemiological Studies Depression Scale (CES-D). Achives Intern Med 159:1701–1704. https://doi.org/10.1001/archinte.159.15.1701

Jang Y, Haley WE, Small BJ, Mortimer JA (2002) The role of mastery and social resources in the associations between disability and depression in later life. Gerontol 42:807–813. https://doi.org/10.1093/geront/42.6.807

Lang FR, Carstensen LL (2002) Time counts: future time perspective, goals, and social relationships. Psychol Aging 17:125–139. https://doi.org/10.1037/0882-7974.17.1.125

Levy BR (2009) Stereotype embodiment: a psychosocial approach to aging. Curr Dir Psychol Sci 18:332–336. https://doi.org/10.1111/j.1467-8721.2009.01662.x

Little TD, Cunningham WA, Shahar G, Widaman KF (2002) To parcel or not to parcel: exploring the question, weighing the merits. Struct Equ Model 9:151–173. https://doi.org/10.1207/S15328007SEM0902_1

Luppa M et al (2012) Age- and gender-specific prevalence of depression in latest-life: systematic review and meta-analysis. J Affect Disord 136:212–221. https://doi.org/10.1016/j.jad.2010.11.033

Luszczynska A, Gutiérrez-Doña B, Schwarzer R (2005) General self-efficacy in various domains of human functioning: evidence from five countries. Int J Psychol 40:80–89. https://doi.org/10.1080/00207590444000041

Maxwell SE, Cole DA (2007) Bias in cross-sectional analyses of longitudinal mediation. Psychol Methods 12:23–44. https://doi.org/10.1037/1082-989X.12.1.23

Meisner BA (2012) A meta-analysis of positive and negative age stereotype priming effects on behavior among older adults. J Gerontol Ser B Psychol Sci Social Sci 67B:13–17. https://doi.org/10.1093/geronb/gbr062

Preacher KJ, Hayes AF (2008) Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behav Res Methods 40:879–891. https://doi.org/10.3758/BRM.40.3.879

Preacher KJ, Kelley K (2011) Effect size measures for mediation models: quantitative strategies for communicating indirect effects. Psychol Methods 16:93–115. https://doi.org/10.1037/a0022658

Radloff LS (1977) The CES-D scale: a self-report depression scale for research in the general population. Appl Psychol Meas 1:385–401. https://doi.org/10.1177/014662167700100306

Raykov T (1997) Estimation of composite reliability for congeneric measures. Appl Psychol Meas 21:173–184. https://doi.org/10.1177/01466216970212006

Roberts BW, Kuncel NR, Shiner R, Caspi A, Goldberg LR (2007) The power of personality: the comparative validity of personality traits, socioeconomic status, and cognitive ability for predicting important life outcomes. Perspect Psychol Sci 2:313–345. https://doi.org/10.1111/j.1745-6916.2007.00047.x

Rosenthal R (1994) Parametric measures of effect size. In: Cooper H, Hedges LV (eds) The handbook of research synthesis. Russell Sage Foundation, New York, pp 231–244

Schieman S, Campbell JE (2001) Age variations in personal agency and self-esteem: the context of physical disability. J Aging Health 13:155–185. https://doi.org/10.1177/089826430101300201

Schwarzer R, Jerusalem M (1995) Generalised self-efficacy scale. In: Weinman J, Wright S, Johnston M (eds) Measures in health psychology: a user's portfolio. Causal and control beliefs. Nfer-Nelson, Windsor, pp 35–37

Siddaway AP, Wood AM, Taylor PJ (2017) The Center for Epidemiologic Studies-Depression (CES-D) scale measures a continuum from well-being to depression: testing two key predictions of positive clinical psychology. J Affect Disord 213:180–186. https://doi.org/10.1016/j.jad.2017.02.015

Stahl ST, Patrick JH (2012) Adults' future time perspective predicts engagement in physical activity. J Gerontol Ser B Psychol Sci Social Sci 67B:413–416. https://doi.org/10.1093/geronb/gbr118

Stephan Y, Caudroit J, Chalabaev A (2011) Subjective health and memory self-efficacy as mediators in the relation between subjective age and life satisfaction among older adults. Aging & Mental Health 15:428–436. https://doi.org/10.1080/13607863.2010.536138

Steunenberg B, Beekman ATF, Deeg DJH, Kerkhof AJFM (2006) Personality and the onset of depression in late life. J Affect Disord 92:243–251. https://doi.org/10.1016/j.jad.2006.02.003

Swann WB Jr (1983) Self-verification: Bringing social reality into harmony with the self. In: Suls J, Greenwald AG (eds) Psychological perspectives on the self, vol 2. Lawrence Erlbaum Associates, Hillsdale, pp 33–66

Teuscher U (2009) Subjective age bias: a motivational and information processing approach. Int J Behav Dev 33:22–31. https://doi.org/10.1177/0165025408099487

Weiss D, Lang FR (2012) "They" are old but "I" feel younger: age-group dissociation as a self-protective strategy in old age. Psychol Aging 27:153–163. https://doi.org/10.1037/a0024887

Windsor TD, Fiori KL, Crisp DA (2011) Personal and neighborhood resources, future time perspective, and social relations in middle and older adulthood. J Gerontol Ser B Psychol Sci Social Sci 67B:423–431. https://doi.org/10.1093/geronb/gbr117

Wurm S, Benyamini Y (2014) Optimism buffers the detrimental effect of negative self-perceptions of ageing on physical and mental health. Psychol Health 29:832–848. https://doi.org/10.1080/08870446.2014.891737

Wurm S, Warner LM, Ziegelmann JP, Wolff JK, Schüz B (2013) How do negative self-perceptions of aging become a self-fulfilling prophecy? Psychol Aging 28:1088–1097. https://doi.org/10.1037/a0032845