Rumination moderates the longitudinal associations of awareness of age-related change with depressive and anxiety symptoms

S Sabatini[1]*, B Dritschel[2], F S Rupprecht[3], O C Ukoumunne[4,5], C Ballard[5], H Brooker[5,6], A Corbett[5], L Clare[4,5]

[1]School of Medicine, University of Nottingham, United Kingdom
[2]School of Psychology and Neuroscience, University of St Andrews, St Andrews, United Kingdom
[3]Department of Developmental and Educational Psychology, University of Vienna, Vienna, Austria
[4]NIHR Applied Research Collaboration South West Peninsula (PenARC), Exeter, UK
[5]University of Exeter Medical School, Exeter, United Kingdom
[6]Ecog Pro Ltd, Bristol, United Kingdom

*Corresponding author
s.sabatini2@exeter.ac.uk
Address: School of Medicine, University of Nottingham, United Kingdom

Abstract

Objective Lower awareness of age-related gains (AARC-gains) and higher awareness of age-related losses (AARC-losses) may be risk factors for depressive and anxiety symptoms. We explored whether: 1) Baseline AARC-gains and AARC-losses predict depressive and anxiety symptoms at one-year follow-up; 2) age and rumination moderate these associations; 3) levels of AARC-gains and AARC-losses differ among individuals with different combinations of current and past depression and/or with different combinations of current and past anxiety.

Methods In this one-year longitudinal cohort study participants (N=3386; mean age=66.0; SD=6.93) completed measures of AARC-gains, AARC-losses, rumination, depression, anxiety, and lifetime diagnosis of depression and anxiety in 2019 and 2020. Regression models with tests of interaction were used.

Results Higher AARC-losses, but not lower AARC-gains, predicted more depressive and anxiety symptoms. Age did not moderate these associations. Associations of lower AARC-gains and higher AARC-losses with more depressive symptoms and of higher AARC-losses with more anxiety symptoms were stronger in those with higher rumination. Individuals with both current and past depression reported highest AARC-losses and lowest AARC-gains. Those with current, but not past anxiety, reported highest AARC-losses.

Conclusion: Perceiving many age-related losses may place individuals at risk of depressive and anxiety symptoms, especially those who frequently ruminate.

Keywords: Mental health, mood, subjective age, gains and losses, prevention

Wordcount (max allowed 8000): 5674

References: 53

Tables: 4 in the main text and 2 as supplementary material

Introduction

Findings from previous studies suggest that at any given time 5% of adults and 7% of older adults (60+ years) are diagnosed with depression and 2% of adults and 3.8% of older adults are diagnosed with generalized anxiety (Bandelow & Michaelis, 2015; World Health Organization, 2022). In older age half of those with depression and one-third of those with anxiety experience late-onset of the illness, having not previously had an episode of depression or anxiety in their life (Brodaty et al., 2001; Le Roux, Gatz, & Wetherell, 2005). Understanding what distinguishes late-life depression and anxiety from recurring episodes of depression and anxiety may help prevent the development of new depressive and anxiety symptoms in older age, as well as their adverse effects on cognitive and physical health and social functioning (Porensky et al., 2009).

Noticing many negative age-related changes and few positive age-related changes may place individuals at risk of new depressive and anxiety symptoms. The concept of awareness of age-related changes (AARC) refers to "a person's state of awareness that his or her behavior, level of performance, or way of experiencing life has changed as a consequence of having grown older" (Diehl & Wahl, 2010; pg. 342). AARC is a two-dimensional construct comprising awareness of positive (AARC-gains) and negative (AARC-losses) age-related changes across five life and behavioral domains: health and physical functioning, cognitive functioning, interpersonal relationships, socio-cognitive and socio-emotional functioning, and lifestyle and engagement. Developmental theories and empirical evidence suggest that AARC-gains and AARC-losses can co-occur (Baltes, 1987; Sabatini et al., 2022). However, during the aging process losses mostly increase whereas gains mostly decrease (Kaspar, Wahl, Diehl, & Zank, 2022). Moreover, although middle aged and older people report some levels of gains and losses across all AARC life and behavioral domains, they consistently perceive highest losses in the physical health and lifestyle domains but highest gains in the interpersonal relationships and socio-cognitive socio-emotional domains (Sabatini, Ukoumunne, Ballard, Brothers, et al., 2020; Sabatini et al., 2022).

Awareness of Age-Related Change and Mental Health

AARC is an emerging concept in gerontology due to its utility in identifying those middle aged and older individuals with poorer mental and physical health (Brothers, Kornadt, Nehrkorn-Bailey, Wahl, & Diehl, 2020; Kaspar et al., 2022; Sabatini, Silarova, et al., 2020; Sabatini, Ukoumunne, Ballard, Collins, et al., 2020; Sabatini, Ukoumunne, Ballard, Collins, Corbett, et al., 2021; Sabatini et al., 2022; Windsor, Abbott, Cations, Howard, & Wilton-

Harding, 2021). Fewer AARC-gains and higher AARC-losses are related to more concurrent depressive and anxiety symptoms, as well as to future depressive symptoms (Dutt & Wahl, 2018; Dutt, Wahl, & Rupprecht, 2018; Sabatini, Ukoumunne, Ballard, Brothers, et al., 2020; Sabatini et al., 2022). However, whether AARC-gains and AARC-losses predict future anxiety symptoms is unknown.

AARC may predict both depressive and anxiety symptoms as the AARC life and behavioral domains capture many risk factors for both later life depression and anxiety. Examples are poor physical health, increased dependence on others, and little or no social support (Fauth, Gerstorf, Ram, & Malmberg, 2012). However, according to the Hopelessness Theory of Depression (Abramson, Metalsky, & Alloy, 1989) it is the interaction between these adverse life experiences and negative cognitive appraisals (e.g., interpreting losses as inevitable) that leads to hopelessness which is a symptom of depression. Hence, people with both a cognitive schema for depression and rumination and who experience many negative changes and events may be those who report highest levels of AARC-losses. Terror Management Theory (Burke, Martens, & Faucher, 2010) instead suggests that interpreting new negative changes as being a consequence of aging may lead to worry, which is a key symptom of anxiety (Spitzer, Kroenke, Williams, & Lowe, 2006).

Previous studies linking AARC to future depression (Dutt et al., 2018) are limited in that they did not control for anxiety despite its high comorbidity with depression (Vink et al., 2009). When exploring the role of AARC-gains and AARC-losses in predicting symptoms of depression and anxiety it is also important to control for prior lifetime diagnosis of depression and anxiety. Indeed, people with a lifetime diagnosis of depression have different life experiences to those without a lifetime diagnosis of depression and, because of this, they may objectively experience more losses (Zisook et al., 2007). Differentiating between recurrent and new cases of depressive and anxiety symptoms makes it possible to understand whether those symptoms of depression and anxiety that occur for the first time in older age are due to the challenges that aging involves (e.g., physical health conditions, Fauth et al., 2012) rather than to entrenched cognitive schemata for depression and/or anxiety (Beck, 2002; Williams, Watts, MacLeod, & Mathews, 1988).

In support of an association between age-related changes and depressive and anxiety symptoms, depressive and anxiety symptoms assume specific characteristics in older age. For instance the prevalence of somatic symptoms of depression, such as weight loss and cognitive dysfunction, is highest in older age (Alexopoulos, 2005). Similarly, among older individuals with anxiety, worries mainly revolve around the topics of health and fear of

falling (Porensky et al., 2009). In summary, the relationship between age-related losses and depressive and anxiety symptoms may explain why the incidence of depression and anxiety is higher in advanced old age compared to early old age (Vink et al., 2009). It is therefore possible that the associations of lower AARC-gains and higher AARC-losses with more depressive and anxiety symptoms become stronger with increasing age.

Awareness of Age-Related Change and rumination

Among individuals reporting high AARC-losses, those with a tendency to ruminate have greater risk of depressive symptoms than those who do not ruminate over the experienced losses (Dutt et al., 2018). Although greater predisposition to ruminate is also related to anxiety symptoms (Treynor, Gonzalez, & Nolen-Hoeksema, 2003), whether rumination moderates the associations of AARC-gains and AARC-losses with anxiety symptoms is unknown. According to Response Style Theory (Nolen-Hoeksema, 1991), rumination exacerbates depressive symptoms because people who ruminate repetitively use negative thoughts and memories as an attempt to understand their current circumstance. They also tend to remain fixated on the problem without taking action and coping with it (Lyubomirsky, Kasri, & Zehm, 2003; Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008).

Previous studies investigating the moderating effect of rumination in the association of AARC with depressive symptoms focused on overall rumination without exploring whether different components of rumination, such as brooding, depression-related rumination, and reflection (Treynor et al., 2003), play a different role in the associations of AARC with depressive and anxiety symptoms. Brooding captures the passive comparison of one's situation with an unachieved standard. Depression-related rumination captures depression-related thoughts such as thinking about lack of concentration and fatigue. Reflection captures thinking about problems with the intent to solve them and reestablish positive mood. Whereas brooding and depression-related rumination may exacerbate depressive and anxiety symptoms, reflection may foster adaptation to age-related changes, and, consequently, enhance mental health (Nolen-Hoeksema et al., 2008; Treynor et al., 2003; Watkins, 2008). In summary, while aging, the experience, and resulting awareness of negative changes, may contribute to depressive and anxiety symptoms. This may be particularly true for those with a tendency to ruminate over the losses experienced.

The current study

This study uses data from a large sample of UK people aged over 50 years to explore: 1) whether AARC-gains and AARC-losses at baseline predict depressive and anxiety symptoms at one-year follow-up, while controlling for baseline levels of depressive and anxiety symptoms and for lifetime diagnosis of depression and anxiety; 2) whether age and/or rumination and its subcomponents (brooding, depression-related rumination, and reflection) moderate the associations of AARC-gains and AARC-losses with depressive and anxiety symptoms; 3) whether levels of AARC-gains and AARC-losses differ among four groups with no current and no history of depression, no current depression but a history of depression, current depression but no history of depression, and current depression and a history of depression. Similarly, this study explores whether levels of AARC-gains and AARC-losses differ among four groups with no current and no history of anxiety, no current anxiety but a history of anxiety, current anxiety but no history of anxiety, and current anxiety and a history of anxiety.

Methods

Study design

This study uses secondary data from the UK PROTECT cohort (Platform for Research Online to investigate Genetics and Cognition in Ageing) collected in 2019 (baseline for this paper) and 2020 (one-year follow-up for this study). Inclusion criteria were being a UK resident, English speaker, aged 50+, having access to the internet, and lacking a clinical diagnosis of dementia at baseline (2015 for the UK PROTECT study). During recruitment the study was publicized nationwide and among existing research cohorts of older adults including *Exeter 10,000*, *Join Dementia Research*, and *Brains for Dementia Research*. At baseline, participants provided informed consent online. The UK PROTECT study has ethical approval from the London Bridge NHS Research Ethics Committee and Health Research Authority (Ref:13/LO/1578).

In 2019, 8697 UK PROTECT participants answered questionnaires assessing AARC and depressive and anxiety symptoms. From this sample, 3386 answered all of them again one year later. Participants included in this paper were similar to those in the wider cohort that were not included in the analyses with respect to socio-demographic variables and anxiety and depressive symptoms at baseline (Supplementary Table 1).

Measures

Socio-demographic variables comprised age, sex, ethnicity, marital status (*married*, *in a civil partnership*; *cohabiting*; *unmarried*; *divorced*; *separated*; *widowed*), education (*secondary education; post-secondary education; vocational qualifications; undergraduate degrees; post-graduate degrees; doctorates*) and employment status (*working; not working*).

Awareness of Age-Related Change (AARC) was measured using the AARC-10 SF (short form) (Kaspar, Gabrian, Brothers, Wahl, & Diehl, 2019) comprised of ten items (listed in Supplementary Table 2): five assessing AARC-gains and five assessing AARC-losses. An item in each of the AARC-gains and AARC-losses subscales represents one of the five AARC life and behavioral domains. Each item starts with the stem: *"With my increasing age, I realize that…".* Respondents rate how much each item applies to them: *not at all* (1); *a little bit* (2); *moderately* (3); *quite a bit* (4); *very much* (5). Scores are obtained for the AARC-gains and AARC-losses subscales by summing the 5 items within the respective subscales. Higher scores indicate higher AARC-gains/losses (range: 5-25). In this sample Cronbach's alpha for internal consistency for the AARC-gains subscale was .75 and for the AARC-losses subscale was .79.

Depressive symptoms over the previous two weeks were assessed with the nine-item Patient Health Questionnaire (Kroenke, Spitzer, & Williams, 2001). For each item respondents indicate how frequently they experienced the selected symptom: *not at all* (1); *several days* (2); *more than half the days* (3); *nearly every day* (4). The total score is the sum of the item scores (range: 9-36); higher scores indicate more depressive symptoms. Scores ≥ 19 indicate presence of depression. Cronbach's alpha in this sample was .92.

Anxiety symptoms over the previous two weeks were assessed with the seven-item Generalized Anxiety Disorder (Spitzer et al., 2006). For each item respondents indicate how frequently they experienced the selected symptom: *not at all* (1); *several days* (2); *more than half the days* (3); *nearly every day* (4). The scale score is the sum of the item scores (range: 7-28); higher scores indicate greater presence of anxiety symptoms. Scores ≥ 12 indicate presence of anxiety. Cronbach's alpha in this sample was .87.

Data on **prior diagnosis of depression and anxiety** were obtained using a question asking participants to report received diagnosis of mental health conditions by a clinical

psychologist. A dichotomous variable was used to indicate whether participants had previously received a diagnosis of depression (1) or not (0). Previous depression comprised diagnosis of depression and or bipolar disorder. Similarly, a dichotomous variable was used to indicate whether participants had previously received a diagnosis of anxiety (1) or not (0). Previous anxiety comprised diagnoses of anxiety; nerves or generalized anxiety disorder; social anxiety or social phobia; and panic attacks.

Rumination was assessed with the 22-item Ruminative Response Scale (Nolen-Hoeksema et al., 2008). For each item, respondents indicated how frequently they engage in the selected thought/behavior: *almost never* (1); *sometimes* (2); *often* (3); *almost always* (4). A total score (range: 22-88), and scores for the subscales brooding (range: 5-20), depression-related rumination (range: 12-48), and reflection (range: 5-20) can be obtained. Higher scores indicate higher rumination. Cronbach's alpha in this sample for the overall score was .92. Cronbach's alpha in this sample for the for the depression-related rumination subscale was .89. Cronbach's alpha in this sample for the for the brooding subscale was .77. Cronbach's alpha in this sample for the for the reflection subscale was .79. In this sample Confirmatory Factor Analyses for the three subscale of rumination led to good model fit indices suggesting that the Ruminative Response Scale well-represents the three subscales of brooding, depression-related rumination, and reflection (Root Mean Square Error of Approximation <.80; Standardized Root Mean Square Residual <.06; Comparative Fit Index and Tucker-Lewis Index ≥ .85).

Analyses

We reported summary statistics for study variables at baseline. We also reported summary statistics of baseline characteristics for those who did and those who did not complete one-year follow-up assessment measures of depressive and anxiety symptoms and AARC.

We fitted linear regression models to examine the relationship of AARC-gains and AARC-losses at baseline (predictors) with depressive and anxiety symptoms at follow-up (outcomes).

We used tests of interaction to examine whether age, rumination, and its subcomponents brooding, depression-related rumination, and reflection moderate the associations of AARC-gains and AARC-losses at baseline with depressive and anxiety symptoms at follow-up. When a test of interaction was statistically significant at the 5% level, we reported the relationship between AARC-gains/AARC-losses and

depressive/anxiety symptoms separately for tertiles of the moderator variable (i.e., age, rumination, brooding, depression-related rumination, and/or reflection).

For each analysis we fitted an unadjusted and an adjusted (for age, sex, marital status, education, and prior diagnosis of depression and anxiety, and baseline levels of depressive and anxiety symptoms) model. To quantify the associations we reported standardized regression coefficients (β; effects sizes). Standardized coefficients ≤.09 were considered negligible, .10-.29 small, .30-.49 moderate, and ≥.50 large (Cohen, 1988).

We used analysis of variance to explore whether levels of AARC-gains and AARC-losses differ among four groups based on current and past presence of depression (no current depression and no history of depression, no current depression but a history of depression, current depression but no history of depression, and current depression and a history of depression) and anxiety (no current anxiety and no history of anxiety, no current anxiety but a history of anxiety, current anxiety but no history of anxiety, and current anxiety and a history of anxiety). For these analyses, the effect size was quantified using eta squared (η^2). For eta squared effect sizes between 0.01 and 0.05 are interpreted as small, between 0.06 and 0.13 are interpreted as moderate and of 0.14 or above are interpreted as large (Cohen, 1988). Analyses were undertaken using STATA version 17.

Results

Descriptive statistics

Descriptive statistics for the study sample are reported in Table 1. In the study sample (N=3386), mean (SD) age was 66.0 years (6.9). The majority of participants were women (77.9%), married (74.6%), and not working (61.8%). Educational achievement varied greatly, but slightly above half had a university degree (54.8%). On average participants had low levels of depressive (mean=11.3; SD=2.9) and anxiety (mean=8.4; SD=2.5) symptoms. A prior diagnosis of depression and anxiety was reported by 14.2% and 5.1% participants, respectively. Average levels of rumination were low (mean=29.4; SD=7.7). On average participants reported “a little bit” of AARC-losses (mean=9.7; SD=3.2) and “moderate” AARC-gains (mean=18.0; SD=3.9).

__Table 1__

Associations of AARC-gains and AARC-losses with depressive and anxiety symptoms

In the adjusted regression model (i.e., controlling for for age, sex, marital status, education, and prior diagnosis of depression and anxiety, and baseline levels of depressive and anxiety symptoms) higher AARC-losses at baseline predicted more depressive symptoms at follow-up (effect size (β)= .23; 95% CI: .20, .26). In the adjusted regression model the relationship between AARC-gains at baseline and depressive symptoms at follow-up was not statistically significant (β= -.03; 95% CI: -.06, .01). Higher AARC-losses at baseline predicted more anxiety symptoms at follow-up (β= .16; 95% CI: .12, .19) whereas AARC-gains at baseline was not a statistically significant predictor of anxiety symptoms at follow-up (β= .02; 95% CI: -.02, .05).

Age as moderator in the associations of AARC-gains and AARC-losses with depressive and anxiety symptoms

In the adjusted models, age was not a statistically significant moderator of the associations of AARC-gains and AARC-losses with depressive and anxiety symptoms (Table 2).

__Table 2__

Rumination as moderator in the associations of AARC-gains and AARC-losses with depressive and anxiety symptoms

In the adjusted models, rumination at baseline significantly moderated the associations of AARC-gains and AARC-losses at baseline with depressive symptoms at follow-up (Table 3). The lowest tertile based group for rumination comprised 1299 participants scoring 22-25 on the Ruminative Response Scale; the middle category for rumination comprised 1030 participants scoring 26-30 on the Ruminative Response Scale; the highest category for rumination comprised 1057 participants scoring 31-87 on the Ruminative Response Scale. Higher AARC-gains predicted fewer depressive symptoms among those in the highest tertile-based category of rumination (β= -.07; 95% CI: -.14, -.01) but not among those in the lowest (β= .02; 95% CI: -.04, .08) or middle (β= .02; 95% CI: -.05, .08) categories. Higher AARC-losses consistently predicted more depressive symptoms across all tertiles of rumination. However, the association was a little stronger among those in the highest category of rumination (β= .19; .95% CI: .12, .25) compared to the associations for those in the lowest (β= .13; 95% CI: .07, .18) and middle (β= .15; 95% CI: .08, .21) categories.

In the adjusted models, rumination moderated the association of AARC-losses, but not that of AARC-gains, with anxiety symptoms (Table 3). Higher AARC-losses predicted higher anxiety symptoms across all tertiles of rumination but associations were stronger in the third tertile (β= .13; 95% CI: .06, .20) compared to the first (β= .08; 95% CI: .03, .14) and second (β= .06; 95% CI: -.01, .12) tertiles.

__Table 3__

Brooding, depression-related rumination, and reflection as moderators in the associations of AARC-gains and AARC-losses with depressive and anxiety symptoms

The moderating roles of brooding, depression-related rumination, and reflection in the associations of AARC-gains and AARC-losses at baseline with depressive or anxiety symptoms at one-year follow-up are reported in Table 4. In the adjusted models, brooding at baseline moderated the associations of AARC-gains at baseline with depressive symptoms at follow-up and of AARC-losses at baseline with depressive and anxiety symptoms at follow-up (Table 4). The lowest, middle, and highest tertile based groups for brooding comprised 1873 (scoring 5-6 on the brooding subscale), 664 (scoring 7 on the brooding subscale), and 868 (scoring 8-20 on the brooding subscale) participants, respectively. Higher AARC-gains predicted fewer depressive symptoms among those reporting highest levels of brooding (β= -.10; 95% CI: -.16, -.03) but not among those with lowest (β= .01; 95% CI: -.04, .05) or middle (β= .06; 95% CI: -.03, .14) levels of brooding. Higher AARC-losses consistently predicted higher depressive symptoms among those in the lowest (β= .20; 95% CI: .16, .24), middle (β= .19; 95% CI: .10, .27), and highest (β= .21; 95% CI: .14, .28) categories of brooding. Higher AARC-losses predicted higher anxiety symptoms among those with lowest (β= .11; 95% CI: .06, .16) and highest (β= .17; 95% CI: .10, .25) levels of brooding but not among those with middle levels of brooding (β= .08; 95% CI: -.01, .16).

In the adjusted models, depression-related rumination at baseline significantly moderated the associations of AARC-losses at baseline with depressive and anxiety symptoms at follow-up and of AARC-gains at baseline with depressive symptoms at follow-up (Table 4). The lowest, middle, and highest tertile based groups for depression-related rumination comprised 1568 (scoring 12-14 on the depression-related rumination subscale), 886 (scoring 15-17 on the depression-related rumination subscale), and 931 (scoring 18-47 on the depression-related rumination subscale) participants, respectively. Higher AARC-gains

predicted fewer depressive symptoms among those reporting highest levels of depression-related rumination (β= -.09; 95% CI: -.16, -.02) but not among those with lowest (β= .04; 95% CI: -.01, .09) or middle (β= .03; 95% CI: -.04, .10) levels of depression-related rumination. Higher AARC-losses were related to more depressive symptoms among those with lowest (β= .12; 95% CI: .07, .17), middle (β= .12; 95% CI: .05, .19) and highest (β= .18; 95% CI: .11, .25) levels of depression-related rumination. Higher AARC-losses predicted more anxiety symptoms among those with lowest (β= .10; 95% CI: .05, .15), middle (β= .07; 95% CI: .003, .14), and highest (β= .09; 95% CI: .02, .17) levels of depression-related rumination.

In the adjusted models, reflection at baseline significantly moderated the associations of AARC-gains at baseline with depressive symptoms at follow-up and of AARC-losses at baseline with depressive and anxiety symptoms at follow-up (Table 4). The lowest tertile based group for reflection comprised 1810 participants who scored 5 on the reflection subscale; the middle category for reflection comprised 525 participants who scored 6 on the reflection subscale; the highest category for reflection comprised 1050 participants who scored 7-20 on the reflection subscale. Higher AARC-gains predicted fewer depressive symptoms among those with middle levels of reflection (β= -.10; 95% CI: -.19, -.02) but not among those with lowest (β= -.01; 95% CI: -.06, .03) or highest (β= -.03; 95% CI= -.10, .03) levels of reflection. Higher AARC-losses consistently predicted more depressive symptoms among those with lowest (β= .22; 95% CI= .18, .26), middle (β= .23; 95% CI: .14, .32), and highest (β= .21; 95% CI: .15, .28) levels of reflection. Higher AARC-losses consistently predicted more anxiety symptoms among those with lowest (β= .12; 95% CI= .08, .17), middle (β= .13; 95% CI: .04, .23), and highest (β= .17; 95% CI: .10, .24) levels of reflection.

Overall, brooding, depression-related rumination, and reflection strengthen the associations of lower AARC-gains and higher AARC-losses with more depressive symptoms at follow-up. They also strengthen the association of higher AARC-losses with more anxiety symptoms at follow-up.

Table 4

Levels of AARC-gains and AARC-losses depending on past and current presence of depression

Table 5 reports levels of AARC-gains and AARC-losses according to past and current presence of depression and anxiety. Levels of AARC-gains and AARC-losses were significantly different in the four groups of participants with no current depression and no history of depression, no current depression but a history of depression, current depression but no history of depression, and current depression and a history of depression. Highest levels of AARC-losses were reported by those with both current depression and a history of depression; followed, in a decreasing order, by those with current depression but no history of depression, no current depression but a history of depression, and no current depression and no history of depression. Levels of AARC-gains were more than two points lower among those with current depression and a history of depression compared to the remaining groups.

Levels of AARC-losses, but not levels of AARC-gains, were significantly different among individuls with no current anxiety and no history of anxiety, no current anxiety but a history of anxiety, current anxiety but no history of anxiety, and current anxiety and a history of anxiety. Highest levels of AARC-losses were reported by those with current anxiety but no history of anxiety, followed, in decreasing order, by those with current anxiety and a history of anxiety, no current anxiety and no history of anxiety, and those with no current anxiety but a history of anxiety.

Table 5

Discussion

This study explored whether: 1) AARC-gains and AARC-losses at baseline predict depressive and anxiety symptoms at one-year follow-up; 2) age, rumination, and its subcomponents (brooding, depression-related rumination, and reflection) moderate the associations of AARC-gains and AARC-losses at baseline with depressive and anxiety symptoms at one-year follow-up; 3) levels of AARC-gains and AARC-losses differ between four groups with no current no history of depression, no current depression but a history of depression, current depression but no history of depression, and current depression and a history of depression. Similarly, it explored whether levels of AARC-gains and AARC-losses differ between four groups with no current no history of anxiety, no current anxiety but a history of anxiety, current anxiety but no history of anxiety, and current anxiety and a history

of anxiety. We found that only higher levels of AARC-losses predicted more depressive and anxiety symptoms. Whereas age did not moderate these associations, associations of lower AARC-gains and higher AARC-losses with more depressive symptoms and of higher AARC-losses with more anxiety symptoms were stronger in those with higher rumination. Individuals with both current and past depression reported highest levels of AARC-losses and lowest levels of AARC-gains. Individuals reporting current, but not past anxiety, reported the highest levels of AARC-losses.

In line with existing longitudinal evidence, higher AARC-losses, but not lower AARC-gains, predicted more depressive symptoms (Dutt, Gabrian, & Wahl, 2016). This was the first longitudinal study to explore the association of AARC with anxiety symptoms. Results suggest that the negative age-related changes people experience while aging may give rise to anxiety (Vink et al., 2009; Vink, Aartsen, & Schoevers, 2008). AARC-gains were not related to either depressive or anxiety symptoms. Hence, when the aim is to prevent new cases of depressive and anxiety symptoms in the second half of life, decreasing AARC-losses and/or promoting acceptance of age-related losses and a focus on the present (i.e. a mindful attitude) could be the priority (Dutt et al., 2018). Age was not a significant moderating factor in the associations of AARC-gains and AARC-losses with depressive and anxiety symptoms, suggesting that high levels of AARC-losses are equally detrimental for mental health in middle, early-old, and old age.

The predictive role of AARC-losses over more depressive and anxiety symptoms was expected as many of the risk factors for depression and anxiety in older age (e.g., poor physical health) are captured in the items assessing AARC-losses (Fauth et al., 2012; Vink et al., 2008). Moreover, as people with depression are past-oriented in the sense that they focus on what they have lost while growing older (Hoffmann, Banzhaf, Kanske, Bermpohl, & Singer, 2016), this feature may also be captured in the items assessing AARC-losses. Additionally, individuals with higher AARC-losses may experience a discrepancy between ideal self and actual self which may exacerbate the negative effects of physical age-related decline on mental health (Heidrich & Powwattana, 2004; Rupprecht & Lang, 2022).

Higher AARC-losses are related to several features that generally characterize individuals with depressive and/or anxiety symptoms. For example, higher AARC-losses are related to less sense of purpose (Windsor et al., 2021), lower self-efficacy (Dutt & Wahl, 2018), little or no perceived control over one's health and life (Zhang & Neupert, 2020), a more negative perception of the future (Wilton-Harding & Windsor, 2021), and the

personality trait of neuroticism (Rupprecht, Dutt, Wahl, & Diehl, 2019). This body of evidence supports the assumption of the Hopelessness Theory of Depression (Abramson et al., 1989) that the combination of adverse life events and negative cognitive appraisal leads to depressive symptoms such as hopelessness. In further support of the Hopelessness Theory of Depression we found that individuals who, in addition to having current depression, also reported a history of depression, suggesting the presence of a persistent negative cognitive appraisal, had higher levels of AARC-losses and lower levels of AARC-gains compared to those with current depression but no history of depression. A history of depression may both place individuals at higher risk of experiencing age-related losses (e.g., cognitive difficulties) (Bunce, Batterham, Christensen, & Mackinnon, 2014) and to pay greater attention to the negative changes they may experience while aging (Abramson et al., 2002; Beck, 2002).

Our results also support Terror Management Theory (Burke et al., 2010) which assumes that interpreting losses as being a consequence of aging leads to anxiety symptoms such as worry. Our findings suggest that some older people may experience anxiety symptoms due to the age-related losses they experience rather than due to them having a more entrenched cognitive schema for anxiety (Beck, 2002; Williams et al., 1988). Indeed, the longitudinal association we found between higher AARC-losses and more anxiety symptoms remained statistically significant after having controlled for baseline anxiety and for history of anxiety. Moreover, in this study individuals with current anxiety but no history of anxiety reported higher levels of AARC-losses than those with current anxiety and a history of anxiety. Hence, it may be that while some older people experience new anxiety symptoms that may be due to age-related challenges, other older people may experience symptoms of anxiety that started earlier in their life and that may not be the consequence of age-related losses.

This study was the first to examine the impact of rumination and its subtypes on AARC gains and losses. Among those with greater levels of rumination, higher AARC-gains predicted fewer depressive symptoms whereas higher AARC-losses predicted more depressive symptoms. The same pattern of results was found when investigating each of the three components of rumination. Therefore rumination seems to exert pernicious effects when thinking repetitively about ARRC-losses but may have benefits when thinking about ARRC-gains. While in the face of negative changes individuals prone to rumination may be more likely to magnify their problems and consequently to experience depressive symptoms; in the face of positive changes, they may equally be more likely to draw their attention to

them. This seems important to decrease the higher levels of depressive symptoms they would otherwise experience.

Ruminating over positive changes may help older individuals to appreciate and accept themselves and their lives and, consequently, to maintain mental health despite the experience of many losses. In support of this reasoning, Windsor et al. (2021) found that higher AARC-gains attenuate the association of higher AARC-losses with poorer psychological well-being. Moreover, while the presence of AARC-gains, and hence of positive thoughts, despite the experience of losses may be an indicator of reduced depressive symptomatology, low AARC-gains and hence the absence of or low positive thoughts may be a further risk factor for depression (Beck, 2002). Indeed, although with increasing age the experience of gains decreases (Kaspar et al., 2022), gains are still very much present throughout the life course (Baltes, 1987; Heckhausen, Dixon, & Baltes, 1989; Sabatini, Ukoumunne, Ballard, Collins, Anstey, et al., 2021; Sabatini et al., 2022).

Similarly to the findings for depressive symptoms, those with higher AARC-losses were even more vulnerable to anxiety symptoms when having high levels of rumination. This finding was expected as rumination is a characteristic of both those experiencing depressive and anxiety symptoms (Nolen-Hoeksema et al., 2008). It may be that, although many people with a tendency to ruminate do not experience episodes of anxiety in the first half of life, when reaching older age and experiencing many age-related losses, they may be more vulnerable to the experience of anxiety symptoms.

The promotion of strategies, such as mindfulness, that help attenuating and/or eradicating ruminative thinking since earlier ages, may help people to grow older with a psychological resource that helps them to cope with age-related losses and protects them from the experience of depressive and anxiety symptoms (Collins & Kishita, 2018; Dutt et al., 2018). Learning to focus on being in the here and now through the practice of mindfulness could also help those older people who are living with untreatable health conditions to accept what they are unable to change (Williams & Penman, 2011). The mental health of middle-aged and older people experiencing many age-related losses could also be enhanced through the implementation of compassion training (Phillips & Ferguson, 2012). Self-compassion refers to the practice of viewing the self through a lens of kindness, especially when facing challenges like those that occur with aging (Neff, 2003). A systematic review by Brown, Huffman, and Bryant (2019) found that self-compassion moderated age-related losses such as declines in physical health. Finally, interventions decreasing AARC-

losses, such as the AgingPLUS program (Diehl et al., 2020), may help promote mental health in older age.

Our longitudinal study design and large sample size made it possible to explore for the first time whether AARC-gains and AARC-losses predict future levels of anxiety symptoms and whether age groups and rumination moderate the associations of AARC-gains and AARC-losses with depressive and anxiety symptoms while controlling for history of depression and anxiety. Taken together, our results suggest that those symptoms of depression and anxiety that arise in older age may be due to the challenges and losses that aging, and in particular old age, brings. The combination of high AARC-losses, low AARC-gains, and ruminative thinking may place middle aged and older individuals at great risk of depressive and anxiety symptoms.

This study, however, has several limitations. First, we used data collected in 2019 and 2020 from a cohort study that started in 2015. It is possible that those who remained in the study are in better health compared to those who dropped out, limiting the generalizability of results. Second, other variables, such as loneliness, social engagement, and trait mindfulness, were not explored in this study, but may also moderate the associations of AARC-gains and AARC-losses with symptoms of depression and anxiety (Dutt et al., 2018; Turner & McLaren, 2011). Third, due to having used the 10-item short-form of the AARC questionnaire and the two resulting subscales assessing AARC-gains and AARC-losses, it was not possible to examine whether the strength of the associations of AARC-gains and AARC-losses with depressive and anxiety symptoms differ according to the AARC life and behavioral domain in which people experience the changes. Fourth, in the analyses we did not control for physical illnesses or medications taken, but it is possible that some people experience symptoms of depression and anxiety that are a direct consequence of physiological changes. However, the longitudinal nature of our data is a strong basis for the causality of AARC-gains and AARC-losses over the development of depressive and anxiety symptoms.

Conclusions

Perceiving many age-related losses may be relevant for the emergence of new cases of poor mental health (i.e., symptoms of depression and anxiety) in older age, especially among those with a tendency to ruminate. The experience of age-related gains, especially among those who tend to be more reflective, may instead be a protective factor against depressive symptoms.

References

Abramson, L. Y., Alloy, L. B., Hankin, B. L., Haeffel, G. J., MacCoon, D. G., & Gibb, B. E. (2002). Cognitive vulnerability-stress models of depression in a self-regulatory and psychobiological context *Handbook of depression* (pp. 268-294). New York, US: Guilford Press.

Abramson, L. Y., Metalsky, G. I., & Alloy, L. B. (1989). Hopelessness depression: A theory-based subtype of depression. *Psychological Review, 96*(2), 358-372. doi: 10.1037/0033-295X.96.2.358

Alexopoulos, G. S. (2005). Depression in the elderly. *The Lancet, 365*(9475), 1961-1970. doi: 10.1016/S0140-6736(05)66665-2

Baltes, P. B. (1987). Theoretical propositions of life-span developmental psychology: On the dynamics between growth and decline. *Developmental Psychology, 23*(5), 611-626. doi: 10.1037/0012-1649.23.5.611

Bandelow, B., & Michaelis, S. (2015). Epidemiology of anxiety disorders in the 21st century. *Dialogues in Clinical Neuroscience, 17*(3), 327-335. doi: 10.31887/DCNS.2015.17.3/bbandelow

Beck, A. T. (2002). Cognitive models of depression. In R. L. Leathy & E. T. Dowd (Eds.), *Clinical Advances in Cognitive Psychotherapy: Theory and Application* (Vol. 14, pp. 29-61). New York, US: Springer Publishing Co.

Brodaty, H., Luscombe, G., Parker, G., Wilhelm, K., Hickie, I., Austin, M. P., & Mitchell, P. (2001). Early and late onset depression in old age: Different aetiologies, same phenomenology. *Journal of Affective Disorders, 66*(2-3), 225-236. doi: 10.1016/S0165-0327(00)00317-7

Brothers, A. F., Kornadt, A. E., Nehrkorn-Bailey, A., Wahl, H.-W., & Diehl, M. K. (2020). The effects of age stereotypes on physical and mental health are mediated by self-perceptions of aging. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 76*(5), 845-857. doi: 10.1093/geronb/gbaa176

Brown, L., Huffman, J. C., & Bryant, C. (2019). Self-compassionate aging: A systematic review. *The Gerontologist, 59*(4), e311-e324. doi: 10.1093/geront/gny108

Bunce, D., Batterham, P. J., Christensen, H., & Mackinnon, A. J. (2014). Causal associations between depression symptoms and cognition in a community-based cohort of older adults. *The American Journal of Geriatric Psychiatry, 22*(12), 1583-1591. doi: 10.1016/j.jagp.2014.01.004

Burke, B. L., Martens, A., & Faucher, E. H. (2010). Two decades of terror management theory: A meta-analysis of mortality salience research. *Personality and Social Psychology Review, 14*(2), 155-195. doi: 10.1177/1088868309352321

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Hillsdale, NJ, United States: Lawrence Earlbaum Associates.

Collins, R. N., & Kishita, N. (2018). The effectiveness of mindfulness- and acceptance-based interventions for informal caregivers of people with dementia: A meta-analysis. *The Gerontologist, 59*(4), e363-e379. doi: 10.1093/geront/gny024

Diehl, M. K., Nehrkorn-Bailey, A., Thompson, K., Rodriguez, D., Li, K., Rebok, G. W., . . . Feltner, S. (2020). The AgingPLUS trial: Design of a randomized controlled trial to increase physical activity in middle-aged and older adults. *Contemporary Clinical Trials, 96*, 106105. doi: 10.1016/j.cct.2020.106105

Diehl, M. K., & Wahl, H.-W. (2010). Awareness of age-related change: Examination of a (mostly) unexplored concept. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 65B*(3), S340-S350. doi: 10.1093/geronb/gbp110

Dutt, A. J., 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. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 73*(6), 944-953. doi: 10.1093/geronb/gbw095

Dutt, A. J., & Wahl, H.-W. (2018). Future time perspective and general self-efficacy mediate the association between awareness of age-related losses and depressive symptoms. *European Journal of Ageing, 16*(2), 227-236. doi: 10.1007/s10433-018-0482-3

Dutt, A. J., Wahl, H.-W., & Rupprecht, F. (2018). Mindful vs. mind full: Processing strategies moderate the association between subjective aging experiences and depressive symptoms. *Psychology and Aging, 33*, 630-642. doi: 10.1037/pag0000245

Fauth, E. B., Gerstorf, D., Ram, N., & Malmberg, B. (2012). Changes in depressive symptoms in the context of disablement processes: Role of demographic characteristics, cognitive function, health, and social support. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 67*(2), 167-177. doi: 10.1093/geronb/gbr078

Heckhausen, J., Dixon, R. A., & Baltes, P. B. (1989). Gains and losses in development throughout adulthood as perceived by different adult age groups. *Developmental Psychology, 25*(1), 109-121. doi: 10.1037/0012-1649.25.1.109

Heidrich, S. M., & Powwattana, A. (2004). Self-discrepancy and mental health in older women with chronic illnesses. *Journal of Adult Development, 11*(4), 251-259. doi: 10.1023/B:JADE.0000044528.54943.5f

Hoffmann, F., Banzhaf, C., Kanske, P., Bermpohl, F., & Singer, T. (2016). Where the depressed mind wanders: Self-generated thought patterns as assessed through experience sampling as a state marker of depression. *Journal of Affective Disorders, 198*, 127-134. doi: 10.1016/j.jad.2016.03.005

Kaspar, R., Gabrian, M., Brothers, A. F., Wahl, H.-W., & Diehl, M. K. (2019). Measuring awareness of age-related change: Development of a 10-Item short form for use in large-scale surveys. *The Gerontologist, 59*(3), e130-e140. doi: 10.1093/geront/gnx213

Kaspar, R., Wahl, H.-W., Diehl, M., & Zank, S. (2022). Subjective views of aging in very old age: Predictors of 2-year change in gains and losses. *Psychology and Aging*. doi: 10.1037/pag0000684

Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9: Validity of a brief depression severity measure. *Journal of General Internal Medicine, 16*(9), 606-613. doi: 10.1046/j.1525-1497.2001.016009606.x

Le Roux, H., Gatz, M., & Wetherell, J. L. (2005). Age at onset of generalized anxiety disorder in older adults. *The American Journal of Geriatric Psychiatry, 13*(1), 23-30. doi: 10.1176/appi.ajgp.13.1.23

Lyubomirsky, S., Kasri, F., & Zehm, K. (2003). Dysphoric rumination impairs concentration on academic tasks. *Cognitive Therapy and Research, 27*(3), 309-330. doi: 10.1023/a:1023918517378

Neff, K. D. (2003). The development and validation of a scale to measure self-compassion. *Self and Identity, 2*(3), 223-250. doi: 10.1080/15298860390209035

Nolen-Hoeksema, S. (1991). Responses to depression and their effects on the duration of depressive episodes. *Journal of Abnormal Psychology, 100*, 569-582. doi: 10.1037/0021-843X.100.4.569

Nolen-Hoeksema, S., Wisco, B. E., & Lyubomirsky, S. (2008). Rethinking rumination. *Perspectives on Psychological Science, 3*(5), 400-424. doi: 10.1111/j.1745-6924.2008.00088.x

Phillips, W. J., & Ferguson, S. J. (2012). Self-compassion: A resource for positive aging. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 68*(4), 529-539. doi: 10.1093/geronb/gbs091

Porensky, E. K., Dew, M. A., Karp, J. F., Skidmore, E., Rollman, B. L., Shear, M. K., & Lenze, E. J. (2009). The burden of late-life generalized anxiety disorder: Effects on disability, health-related quality of life, and healthcare utilization. *The American Journal of Geriatric Psychiatry, 17*(6), 473-482. doi: 10.1097/JGP.0b013e31819b87b2

Rupprecht, F. S., Dutt, A. J., Wahl, H.-W., & Diehl, M. K. (2019). The role of personality in becoming aware of age-related changes. *The Journal of Gerontopsychology and Geriatric Psychiatry, 32*(2), 57-67. doi: 10.1024/1662-9647/a000204

Rupprecht, F. S., & Lang, F. R. (2022). Subjective views on longevity *Subjective Views of Aging* (pp. 77-95): Springer.

Sabatini, S., Silarova, B., Martyr, A., Collins, R., Ballard, C., Anstey, K. J., . . . Clare, L. (2020). Associations of awareness of age-related change with emotional and physical well-being: A systematic review and meta-analysis. *The Gerontologist, 60*(6), e477-e490. doi: 10.1093/geront/gnz101

Sabatini, S., Ukoumunne, O. C., Ballard, C., Brothers, A. F., Kaspar, R., Collins, R., . . . Clare, L. (2020). International relevance of two measures of awareness of age-related change (AARC). *BMC Geriatrics, 20*(1), 359. doi: 10.1186/s12877-020-01767-6

Sabatini, S., Ukoumunne, O. C., Ballard, C., Collins, R., Anstey, K. J., Diehl, M. K., . . . Clare, L. (2021). Cross-sectional association between objective cognitive performance and perceived age-related gains and losses in cognition. *International Psychogeriatrics, 33*, 727-741. doi: 10.1017/S1041610221000375

Sabatini, S., Ukoumunne, O. C., Ballard, C., Collins, R., Corbett, A., Brooker, H., & Clare, L. (2020). The cross-sectional relationship between pain and awareness of age-related changes. *British Journal of Pain, 15*(3), 335-344. doi: 10.1177/2049463720961798

Sabatini, S., Ukoumunne, O. C., Ballard, C., Collins, R., Corbett, A., Brooker, H., & Clare, L. (2021). Exploring awareness of age-related changes among over 50s in the UK: Findings from the PROTECT study. *International Psychogeriatrics, 34*(9), 789-803. doi: 10.1017/S104161022100123X

Sabatini, S., Ukoumunne, O. C., Brothers, A., Diehl, M., Wahl, H.-W., Ballard, C., . . . Clare, L. (2022). Differences in awareness of positive and negative age-related changes accounting for variability in health outcomes. *European Journal of Ageing*. doi: 10.1007/s10433-021-00673-z

Spitzer, R. L., Kroenke, K., Williams, J. B., & Lowe, B. (2006). A brief measure for assessing generalized anxiety disorder: The GAD-7. *Archives of Internal Medicine, 166*(10), 1092-1097. doi: 10.1001/archinte.166.10.1092

Treynor, W., Gonzalez, R., & Nolen-Hoeksema, S. (2003). Rumination reconsidered: A psychometric analysis. *Cognitive Therapy and Research, 27*(3), 247-259. doi: 10.1023/a:1023910315561

Turner, L., & McLaren, S. (2011). Social support and sense of belonging as protective factors in the rumination–depressive symptoms relation among Australian women. *Women & Health, 51*(2), 151-167. doi: 10.1080/03630242.2011.558004

Vink, D., Aartsen, M. J., Comijs, H. C., Heymans, M. W., Penninx, B. W., Stek, M. L., . . . Beekman, A. T. (2009). Onset of anxiety and depression in the aging population: Comparison of risk factors in a 9-year prospective study. *The American Journal of Geriatric Psychiatry, 17*(8), 642-652. doi: 10.1097/JGP.0b013e3181a65228

Vink, D., Aartsen, M. J., & Schoevers, R. A. (2008). Risk factors for anxiety and depression in the elderly: A review. *Journal of Affective Disorders, 106*(1-2), 29-44. doi: 10.1016/j.jad.2007.06.005

Watkins, E. R. (2008). Constructive and unconstructive repetitive thought. *Psychological Bulletin, 134*(2), 163-206. doi: 10.1037/0033-2909.134.2.163

Williams, M., & Penman, D. (2011). *Mindfulness: A practical guide to finding peace in a frantic world*: Hachette UK.

Williams, M., Watts, F. N., MacLeod, C., & Mathews, A. (1988). *Cognitive psychology and emotional disorders*: John Wiley & Sons.

Wilton-Harding, B., & Windsor, T. D. (2021). Awareness of age-related change, future time perspective, and implications for goal adjustment in older adulthood. *Aging & Mental Health*, 1-9. doi: 10.1080/13607863.2021.1893269

Windsor, T. D., Abbott, M. J., Cations, M., Howard, A. J., & Wilton-Harding, B. (2021). Subjective perceptions of age-related gains buffer negative associations of perceived age-related losses with health, well-being, and engagement. *International Journal of Behavioral Development*, 01650254211039025. doi: 10.1177/01650254211039025

World Health Organization. (2022). *Mental health of older adults*. Retrieved from http://www.who.int/news-room/fact-sheets/detail/mental-health-of-older-adults

Zhang, S., & Neupert, S. D. (2020). Awareness of aging mediates the relationship between health and control beliefs: A micro-longitudinal study. *Innovation in Aging, 4*(Suppl 1), 448-448. doi: 10.1093/geroni/igaa057.1449

Zisook, S., Lesser, I., Stewart, J. W., Wisniewski, S. R., Balasubramani, G. K., Fava, M., . . . Nierenberg, A. A. (2007). Effect of age at onset on the course of major depressive disorder. *American Journal of Psychiatry, 164*(10), 1539-1546. doi: 10.1176/appi.ajp.2007.06101757

Funding

This work was supported by the University of Exeter College of Life and Environmental Sciences (School of Psychology), University of Exeter College of Medicine and Health, and the National Health and Medical Research Council Centre for Research Excellence in Cognitive Health [#1100579 to Kaarin Anstey].

This paper represents independent research part funded by the National Institute for Health and Care Research (NIHR) Biomedical Research Centre at South London and Maudsley NHS Foundation Trust and King's College London.

Acknowledgment

This paper represents independent research funded by the National Institute for Health and Care Research (NIHR) Biomedical Research Centre at South London and Maudsley NHS Foundation Trust and King's College London. Obi Ukoumunne and Linda Clare were supported by the National Institute for Health and Care Research (NIHR) Applied Research Collaboration (ARC) South West Peninsula. The views expressed are those of the author(s) and not necessarily those of the NHS, the NIHR or the Department of Health and Social Care.

Conflicts of interest

The authors have no conflicts of interest to declare.

Availability of data and materials

This study was conducted using secondary data collected as part of the PROTECT ongoing study. PROTECT data are available to investigators outside the PROTECT team after request and approval by the PROTECT Steering Committee.

Declaration of contribution of authors

S S served as principal investigator of the research, designed the study, conducted data analyses, and took the lead in writing the manuscript.

O U and F S R provided feedback on the analyses and draft of the manuscript.

B D contributed to the interpretation of study results and provided feedback on the draft of the manuscript

A C, H B, C B contributed to data collection and design of the PROTECT study, and provided feedback on the draft of the manuscript.

L C provided feedback on the draft of the manuscript.

Table 1. Descriptive statistics of main study variables at baseline for the study sample

Variable	Total study sample (N= 3386)
Age; mean (SD; range)	66.04 (6.93; 51-95)
Women, n (%)	2640 (77.9)
Married/ in a civil partnership/ cohabiting, n (%)	2525 (74.6)
White ethnicity, n (%)	3341 (98.7)
Education, n (%)	
Secondary education	465 (13.7)
Post-secondary education	396 (11.7)
Vocational qualification	670 (19.8)
Undergraduate degree	1171 (34.6)
Post-graduate degree	558 (16.5)
Doctorate	126 (3.7)
Working, n (%)	1294 (38.2)
Prior diagnosis of depression, n (%)	480 (14.2)
Prior diagnosis of anxiety, n (%)	173 (5.1)
Depressive symptoms, mean (SD)	11.31 (2.90; 9-34)
Anxiety symptoms, mean (SD)	8.39 (2.49; 7-28)
Rumination, mean (SD)	29.39 (7.66; 22-87)
Brooding, mean (SD)	6.82 (1.98; 5-20)
Depression-related rumination, mean (SD)	16.24 (4.53; 12-47)
Reflection, mean (SD)	6.33 (2.04; 5-20)
AARC-gains, mean (SD)	17.99 (3.85; 5-25)
AARC-losses, mean (SD)	9.72 (3.18; 5-25)

Table 2. Age as moderator in the associations of AARC-gains and AARC-losses at baseline with depressive or anxiety symptoms at one-year follow-up.

	Depressive symptoms as outcome					
	Unadjusted model			Adjusted model		
	B (95% CI)	*p*-value	β	B (95% CI)	*p*-value	β
Interaction between AARC-gains at baseline and age	-.0004 (-.004; .003)	.819	-.04	-.001 (-.004; .002)	.407	-.21
	Depressive symptoms as outcome					
	Unadjusted model			Adjusted model		
	B (95% CI)	*p*-value	β	B (95% CI)	*p*-value	β
Interaction between AARC-losses at baseline and age	-.01 (-.01; -.002)	.002	-.47	-.003 (-.01; .0002)	.067	-.13
	Anxiety symptoms as outcome					
	Unadjusted model			Adjusted model		
	B (95% CI)	*p*-value	β	B (95% CI)	*p*-value	β
Interaction between AARC-gains at baseline and age	.0003 (-.003; .003)	.864	.03	-.001 (-.004 .002)	.516	.01
	Anxiety symptoms as outcome					
	Unadjusted model			Adjusted model		
	B (95% CI)	*p*-value	β	B (95% CI)	*p*-value	β
Interaction between AARC-losses at baseline and age	-.01 (-.01; -.003)	<.001	-.57	-.003 (-.01; .001)	.099	-.34

Note. Adjusted for sex, marital status, education, previous diagnosis of depression and anxiety, and baseline levels of depression and anxiety. B= Non standardized regression coefficient. β= Standardized regression coefficient.

Table 3. Rumination at baseline as moderator in the associations of AARC-gains and AARC-losses at baseline with depressive or anxiety symptoms at one-year follow-up.

Depressive symptoms as outcome						
	Unadjusted model			Adjusted model		
	B (95% CI)	*p*-value	β	B (95% CI)	*p*-value	β
Interaction between AARC-gains at baseline and rumination at baseline	-.01 (-.01; -.01)	<.001	-.66	-.01 (-.01; -.002)	<.001	-.33
Depressive symptoms as outcome						
	Unadjusted model			Adjusted model		
	B (95% CI)	*p*-value	β	B (95% CI)	*p*-value	β
Interaction between AARC-losses at baseline and rumination at baseline	.01 (.003; .01)	<.001	.32	.004 (.001; .01)	.003	.23
Anxiety symptoms as outcome						
	Unadjusted model			Adjusted model		
	B (95% CI)	*p*-value	β	B (95% CI)	*p*-value	β
Interaction between AARC-gains at baseline and rumination at baseline	-.005 (-.01; -.002)	<.001	-.33	-.001 (-.003; .002)	.585	-.05
Anxiety symptoms as outcome						
	Unadjusted model			Adjusted model		
	B (95% CI)	*p*-value	β	B (95% CI)	*p*-value	β
Interaction between AARC-losses at baseline and rumination at baseline	.003 (.001; .01)	.003	.22	.004 (.001; .01)	.003	.25

Note. Adjusted for sex, marital status, education, previous diagnosis of depression and anxiety, and baseline levels of depression and anxiety. B= Non standardized regression coefficient. β= Standardized regression coefficient.

Table 4. Brooding, depression-related rumination, and reflection as moderators in the associations of AARC-gains and AARC-losses at baseline with depressive or anxiety symptoms at one-year follow-up.

Depressive symptoms as outcome						
	Unadjusted model			Adjusted model		
	B (95% CI)	*p*-value	β	B (95% CI)	*p*-value	β
Interaction between AARC-gains and brooding rumination	-.04 (-.05; -.03)	<.001	-.62	-.01 (-.02; -.001)	.029	-.19
Depressive symptoms as outcome						
	Unadjusted model			Adjusted model		
	B (95% CI)	*p*-value	β	B (95% CI)	*p*-value	β
Interaction between AARC-losses and brooding rumination	.03 (.02; .04)	<.001	.40	.02 (.01; .03)	.001	.25
Anxiety symptoms as outcome						
	Unadjusted model			Adjusted model		
	B (95% CI)	*p*-value	β	B (95% CI)	*p*-value	β
Interaction between AARC-gains and brooding	-.01 (-.02; -.01)	.003	-.23	.001 (-.01; .01)	.790	.02
Anxiety symptoms as outcome						
	Unadjusted model			Adjusted model		
	B (95% CI)	*p*-value	β	B (95% CI)	*p*-value	β
Interaction between AARC-losses and brooding	.02 (.01; .03)	<.001	.25	.02 (.01; .03)	<.001	.28
Depressive symptoms as outcome						
	Unadjusted model			Adjusted model		
	B (95% CI)	*p*-value	β	B (95% CI)	*p*-value	β
Interaction between AARC-gains and depression-related rumination	-.02 (-.02; -.02)	<.001	-.67	-.01 (-.02; -.01)	<.001	-.37
Depressive symptoms as outcome						
	Unadjusted model			Adjusted model		
	B (95% CI)	*p*-value	β	B (95% CI)	*p*-value	β
Interaction between AARC-losses and depression-related rumination	.01 (.003; .01)	<.001	.24	.01 (.001; .01)	.018	.18
Anxiety symptoms as outcome						
	Unadjusted model			Adjusted model		
	B (95% CI)	*p*-value	β	B (95% CI)	*p*-value	β

Interaction between AARC-gains and depression-related rumination	-.01 (-.01; -.01)	<.001	-.37	-.003 (-.01; .002)	.270	-.11
Anxiety symptoms as outcome						
	Unadjusted model			Adjusted model		
	B (95% CI)	*p*-value	β	B (95% CI)	*p*-value	β
Interaction between AARC-losses and depression-related rumination	.01 (.002; .01)	.006	.21	.01 (.001; .01)	.019	.20
Depressive symptoms as outcome						
	Unadjusted model			Adjusted model		
	B (95% CI)	*p*-value	β	B (95% CI)	*p*-value	β
Interaction between AARC-gains and reflection	-.04 (-.05; -.03)	<.001	-.62	-.01 (-.03; -.003)	.014	-.23
Depressive symptoms as outcome						
	Unadjusted model			Adjusted model		
	B (95% CI)	*p*-value	β	B (95% CI)	*p*-value	β
Interaction between AARC-losses and reflection	.04 (.03; .06)	<.001	.51	.03 (.01, .04)	<.001	.31
Anxiety symptoms as outcome						
	Unadjusted model			Adjusted model		
	B (95% CI)	*p*-value	β	B (95% CI)	*p*-value	β
Interaction between AARC-gains and reflection	-.02 (-.03; -.01)	<.001	-.42	-.001 (-.01; .01)	.850	-.02
Anxiety symptoms as outcome						
	Unadjusted model			Adjusted model		
	B (95% CI)	*p*-value	β	B (95% CI)	*p*-value	β
Interaction between AARC-losses and reflection rumination	.03 (.02; .04)	<.001	.36	.03 (.01; .04)	<.001	.36

Adjusted for sex, marital status, education, previous diagnosis of depression and anxiety, and depression and anxiety at baseline.

Table 5. Levels of AARC-gains and AARC-losses according to past and current presence of depression and anxiety.

	AARC-gains					AARC-losses				
Depression category	Mean	SD	Number of participants	P value	Eta squared	Mean	SD	Number of participants	P value	Eta squared
No current depression and no history of depression	18.32	3.74	2167	.018	.004	9.62	3.02	2167	<.001	.05
No current depression but a history of depression	18.47	3.69	455			10.43	3.31	455		
Current depression but no history of depression	18.37	4.15	35			13.83	4.38	35		
Current depression and a history of depression	16.08	4.20	26			14.96	5.36	26		
	AARC-gains					AARC-losses				
	Mean	SD	Number of participants	P value	Eta squared	Mean	SD	Number of participants	P value	Eta squared
No current anxiety and no history of anxiety	18.31	3.71	2308	.329	.001	9.68	3.05	2308	<.001	.04
No current anxiety but a history of anxiety	18.83	3.61	136			9.53	2.72	136		
Current anxiety but no history of anxiety	18.12	4.10	199			12.13	4.14	199		
Current anxiety and a history of anxiety	18.69	4.39	36			10.69	3.93	36		