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Research Article

Within-Person Associations of Self-Reports of Memory Impairment and Depressive Symptoms in Older Adults: Moderation of Relationships Over Time by Personality

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Abstract

Objectives: The current study examined within-person associations of self-reports of impaired current memory functioning and perceived decline with depressive symptoms in older adults without cognitive impairment, and whether these associations were moderated by individuals' levels of neuroticism, conscientiousness, and extraversion.

Methods: Samples were drawn from the Einstein Aging Study, Rush Memory and Aging Project (MAP), Minority Aging Research Study (MARS), Health and Retirement Study (HRS), and National Health and Aging Trends Study (NHATS), with over 8,000 participants (65+ years) included across data sets. In a series of coordinated analyses, multilevel linear models tested within-person relationships over periods of up to 22 years.

Results: Across HRS and NHATS samples, self-reports of impaired current memory functioning covaried with depressive symptoms over time. This association was moderated by neuroticism, such that the association was stronger for individuals with higher levels of neuroticism. Across all samples, perceived memory decline covaried with depressive symptoms over time. This association was moderated by neuroticism in MAP/MARS, HRS, and NHATS, such that the association was stronger for individuals with higher levels of neuroticism.

Discussion: Self-reports of impaired current memory functioning and perceived memory decline are important determinants of older adults' psychological well-being. In our results, at times when older adults perceive poorer memory functioning or decline, they also tend to report more depressive symptoms. Further, results from two larger data sets suggest that individuals' level of neuroticism may determine the extent to which self-reports of memory impairment and depressive symptoms covary over time.

Keywords: Coordinated analyses, Multilevel linear modeling, Within-person associations

Perceptions of memory impairment in the absence of objective testing deficits are frequently cited as a potential early indicator of cognitive decline in older adults (Choe et al., 2018). However, these perceptions are sensitive to other psychological states (e.g., depression) and traits (e.g., personality) cross-sectionally, limiting their utility in identifying those individuals most likely to be experiencing non-normative cognitive decline, such as Alzheimer's disease (AD). Less well understood are how perceived memory impairment (collected via self-reports)

and depressive symptoms covary within individuals across time and the role of personality in these longitudinal associations. The current paper addresses this gap by presenting a coordinated analysis (Hofer & Piccinin, 2009) across five large longitudinal studies to explore the within-person coupling of reports of memory impairment with depressive symptoms and whether this coupling depends on three personality traits identified as important in previous work: neuroticism, extraversion, and conscientiousness (Hill et al., 2019).

Depressive symptoms are often associated with concurrent reports of memory problems in older adults without objective cognitive impairments. Older adults with higher depressive symptoms tend to report more memory problems than their peers (Bhang et al., 2020; Yates et al., 2017). This is consistent with the symptomatology of depression, which includes cognitive symptoms in addition to negative affect (Doumas et al., 2012). Common measures of depression used with older adults capture this, such as the inclusion of the item "Do you feel you have more problems with memory than most?" in the Geriatric Depression Scale (GDS; Sheikh & Yesavage, 1986). A systematic review of 39 cross-sectional studies consistently identified a significant relationship between self-reported memory impairment and depressive symptoms (Hill et al., 2016), establishing strong evidence that older adults who report more depressive symptoms also tend to report memory impairments.

In contrast, longitudinal evidence for this relationship from the growing literature connecting reports of memory impairment to depressive symptoms is mixed. Consistent with cross-sectional work, older adults reporting memory impairment at baseline are more likely to experience greater depressive symptoms at later time points (Heun & Hein, 2005; Potvin et al., 2013). Additionally, some research suggests that when older adults begin perceiving memory problems, depressive symptoms tend to worsen (Zimprich et al., 2003). Importantly, more recent work has indicated that reports of memory impairment, particularly reports of a decline in memory functioning, tend to precede higher depressive symptoms over time, rather than vice versa (Bhang et al., 2020; Mogle et al., 2020). However, the number of studies examining these relationships is limited (Hill et al., 2016). As reports of memory impairment show promising predictive validity of future decrements in emotional and cognitive health, it is critical to develop additional evidence for these longitudinal relationships and determine whether certain subgroups of older adults are more or less likely to show these dynamic associations of self-reported memory impairment and depressive symptoms. Previous longitudinal work has not typically accounted for person-level moderators that might affect reporting of memory impairments and depressive symptoms, such as personality.

Personality is frequently characterized by the Five-Factor Model in aging research, and of these traits, neuroticism (tendency to experience negative emotions), and conscientiousness (tendency to be reliable, planful) are most consistently related with self-reported memory impairment (Luchetti et al., 2016; Steinberg et al., 2013). Higher neuroticism is consistently related to greater reported memory impairment (Koller et al., 2019; Luchetti et al., 2016), while higher conscientiousness is related to lower reports of memory impairment (Luchetti et al., 2016; Steinberg et al., 2013). Extraversion (tendency to be expressive, active) is inconsistently related to these reports, with some finding that higher extraversion is related to less frequent reports of memory impairment (Luchetti et al., 2016; Steinberg et al., 2013), and others finding no association (Könen & Karbach, 2020; Studer et al., 2014). Importantly, each of these personality traits is also linked to depressive symptoms with higher neuroticism, lower extraversion, and lower conscientiousness associated with greater severity of depressive symptoms in older adults (Hayward et al., 2013; Koorevaar et al., 2013, 2017) and neuroticism as the most powerful predictor in this population (Fiske et al., 2009).

Given the associations of higher neuroticism and lower conscientiousness with self-reported memory impairment and greater severity of depressive symptoms, it is likely that they may moderate the longitudinal relationships among these constructs in older adults. As individuals lower in neuroticism and those higher in conscientiousness tend to use more resourceful and effective coping strategies (Bartley & Roesch, 2011; Bolger & Zuckerman, 1995; Penley & Tomaka, 2002), older adults with these tendencies who are experiencing memory problems may cope more effectively, leading to a weaker relationship with their depressive symptoms. In contrast, older adults higher in extraversion tend to have higher confidence about perceived abilities (Löckenhoff et al., 2008), which could buffer the detrimental effects of self-reported memory impairment on depressive symptoms. A better understanding of how personality influences such relationships over time can help identify individuals at risk for negative emotional effects associated with the experience of memory problems.

An important consideration in any examination of reports of memory impairment is the approach to assessment. It is not unusual for studies to assess memory impairments with a single item (Reid & MacLullich, 2006), and items differ extensively across studies (Rabin et al., 2015). For example, individuals may be asked about their current memory performance (e.g., How would you rate your memory?) or perceptions of decline over time (e.g., Compared to *n* years ago, how is your memory now? [where *n* varies from 1 to 5 to 10 and beyond]), constructs that reflect different aspects of the experience of memory impairment. Studies that have examined whether the type of item used to assess memory impairment influences relationships with affective symptoms, including depressive symptoms, have consistently found that item type matters. Reports of memory decline, for example, were consistently associated with future depressive symptoms but ratings of current memory performance were not (Mogle et al., 2020).

In order to address these gaps, the current study examined within-person relationships among self-reports of memory impairment and depressive symptoms and replicated analyses across four large data sets from five studies of aging spanning up to 22 years. We considered the moderating role of personality (specifically neuroticism, extraversion, and conscientiousness) on longitudinal associations, as well as whether conclusions depended on the type of self-reported memory impairment (impaired current functioning or perceived decline). We tested the following hypotheses:

1. At times when reports of memory impairment are higher, depressive symptoms will also be higher (i.e., within-person associations; H1).
2. Relationships will be stronger among individuals with higher neuroticism, lower conscientiousness, and lower extraversion (H2).
3. All relationships will be stronger for reports focused on perceived memory decline relative to reports focused on impaired current memory functioning (H3).

We will address these questions using a coordinated analysis framework. In a coordinated analysis, analyses are replicated across several data sets that assessed the same latent constructs though typically using different operationalizations. Equivalent model specifications are used in each of the data sets so that substantive conclusions can be efficiently compared and contrasted to facilitate building of evidence for (or against) the relationships of interest.

Method

Participants

Samples were drawn from five longitudinal studies of aging: the Einstein Aging Study (EAS; Lipton et al., 2003), the Rush Memory and Aging Project (MAP; Bennett et al., 2018), the Minority Aging Research Study (MARS; Barnes et al., 2012), the Health and Retirement Study (HRS; Health and Retirement Study, 1998–2014; Sonnega et al., 2014), and the National Health and Aging Trends Study (NHATS; Kasper & Freedman, 2018; NHATS Public Use Data, 2011–2017). All studies obtained institutional ethics approval. Data were collected annually for EAS, MAP, MARS, and NHATS and biennially for HRS (see Supplementary Table 1 for study descriptions); all participants across studies provided written informed consent. Participants were included if they were 65 years of age or older, completed self-reports of memory and personality measures, completed interviews in English, and had no evidence of mild cognitive impairment (MCI), AD, or other dementia per the parent study protocols (EAS, MAP, MARS). As NHATS and HRS do not identify individuals with MCI or dementia as part of their protocol, we used objective cognitive assessments and participants' self-report of AD or dementia to determine whether they had MCI or dementia. We first excluded participants who either self-reported having dementia or AD. Next, we excluded participants who scored less than or equal to 1.5 *SD* below the normative mean on one or more cognitive domains at two contiguous waves, or at the last available wave (see Kasper & Freedman, 2018). Across all data sets, the number of participants who identified as Hispanic, Other, or did not identify with any race/ethnicity was small (1.02% to 7.31%). Therefore, they were excluded from the current study to avoid an unbalanced racial/ethnic sample which could make it difficult to identify differences in effects due to race/ethnicity. A flowchart outlining the sample identification process is provided in Figure 1. The current study combined MAP and MARS data sets for analyses as the recruitment techniques, study methods, and measures of interest are the same across the two data sets.

The EAS sample included 431 participants (~72% White; ~28% Black; ~63% female; M_{age} = 76.68, *SD* = 4.70), with up to 11 waves of data (1993–2003) per participant. We included 940 older adults from MAP/MARS (~63% White; ~37% Black; ~78% female; M_{age} = 76.40, *SD* = 7.10), with up to 22 waves of data (MARS: 1997–2018; MAP: 2004–2018) per participant. The HRS sample included 5,238 participants (~93% White; ~7% Black; ~59% Female; M_{age} = 66.80, *SD* = 3.01), with up to nine waves of data (1996–2014) per participant (because HRS collects data biennially, this represents an 18-year period). The NHATS sample included 1,728 participants (~82% White; ~18% Black; 59% female; M_{age} = 70–74, *SD* = 1.35), with up to seven waves of data (2011–2017) per participant. Full sample demographics are presented in Table 1.

Measures

For the purposes of coordinated analyses and to draw substantive conclusions from results across studies, education,

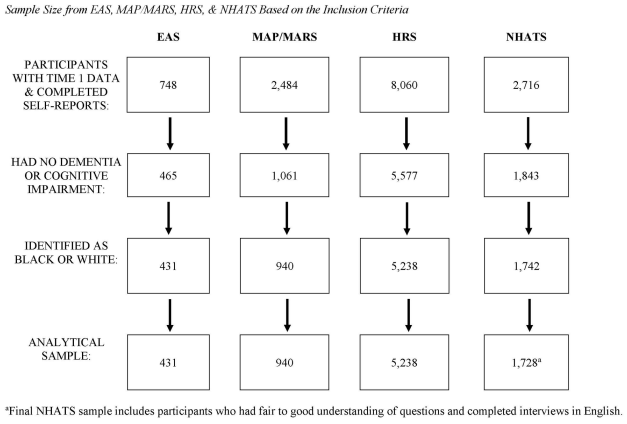

Figure 1. Sample size from EAS, MAP/MARS, HRS, & NHATS based on the inclusion criteria. EAS = Einstein Aging Study; HRS = Health and Retirement Study; MAP = Memory and Aging Project; MARS = Minority Aging Research Study; NHATS = National Health and Aging Trends Study.

Table 1. Participant Characteristics by Study

Characteristics	EAS (*n* = 431)	MAP/MARS (*n* = 940)	HRS (*n* = 5,238)	NHATS (*n* = 1,728)
Age[a]				
65–69	M_{age} = 76.68 (4.70)	M_{age} = 76.40 (7.10)	M_{age} = 66.80 (3.01)	447 (25.87)
70–74				431 (24.94)
75–79				360 (20.83)
80–84				314 (18.17)
85–89				116 (6.71)
90+				60 (3.47)
Education				
Less than high school, *n* (%)	34 (7.89)	45 (4.79)	627 (11.92)	269 (15.57)
High school, *n* (%)	98 (22.74)	194 (20.64)	1,827 (34.89)	494 (28.59)
Some college, *n* (%)	97 (22.51)	282 (30.00)	1,295 (24.73)	463 (26.79)
College and beyond, *n* (%)	202 (46.87)	419 (44.57)	1,487 (28.40)	502 (29.05)
Sex				
Female, *n* (%)	271 (62.88)	732 (77.87)	3,114 (59.45)	1,012 (58.56)
Male, *n* (%)	160 (37.12)	208 (22.13)	2,124 (40.55)	716 (41.44)
Race				
White, *n* (%)	310 (71.93)	591 (62.87)	4,860 (92.78)	1,423 (82.35)
Black, *n* (%)	121 (28.07)	349 (37.13)	378 (7.22)	305 (17.65)
Income				
Less than $15,000, *n* (%)	40 (9.98)	105 (11.80)	382 (7.29)	831 (48.09)
$15,001–$30,000, *n* (%)	137 (34.16)	189 (21.24)	1,031 (19.68)	235 (13.60)
Greater than $30,000, *n* (%)	224 (55.86)	596 (66.97)	3,825 (73.02)	662 (38.31)
Follow-up years, *M* (*SD*)	2.99 (2.69)	4.07 (3.72)	2.84 (2.29)	3.12 (2.24)
Memory problem frequency, *M* (*SD*)	2.63 (0.70)	3.14 (0.86)	NA	NA
Current memory rating, *M* (*SD*)	NA	NA	2.80 (0.86)	2.49 (0.90)
Perceived 1-year memory decline, *n* (% yes)	61 (14.52)	NA	NA	166 (9.61)
Perceived 2-year memory decline, *n* (% yes)	NA	NA	930 (17.75)	NA
Perceived 10-year memory decline, *n* (% yes)	258 (61.58)	712 (75.83)	NA	NA
Neuroticism, *M* (*SD*)	20.64 (6.20)	13.68 (6.87)	7.70 (2.32)	4.40 (1.64)
Conscientiousness, *M* (*SD*)	38.46 (6.44)	NA	17.07 (2.28)	6.60 (1.36)
Extraversion, *M* (*SD*)	34.11 (6.44)	NA	16.01 (2.75)	6.36 (1.45)

Notes: EAS = Einstein Aging Study; HRS = Health and Retirement Study; MAP = Memory and Aging Project; MARS = Minority Aging Research Study; NA = not available; NHATS = National Health and Aging Trends Study.
[a]Age was included as a continuous variable in EAS, MAP/MARS, and HRS.

income, and perceived memory decline variables were recoded to create equivalent versions across all data sets (see Supplementary Table 2 for measure details, including item wording and response options). Descriptive statistics for study measures described below are provided in Supplementary Tables 3 and 4.

Self-reported memory impairment

Across data sets, multiple items were used to measure self-reported impaired current memory functioning and perceived memory decline. Impaired current memory functioning was measured as either current memory problem frequency (EAS, MAP, MARS) or current memory rating (HRS, NHATS). Perceived memory decline was measured as perceived 1-year memory decline (EAS, NHATS), perceived 2-year memory decline (HRS), or perceived 10-year memory decline (EAS, MAP/MARS). Response options for current memory problem frequency and current memory rating were reverse-coded or recoded as needed, such that higher scores represent more impaired current memory functioning. Response options for perceived memory decline were recoded to dichotomous variables in each data set (0 = no decline; 1 = decline) due to: (a) the low frequency (~1%–4%) of participants reporting that their memory improved over time, and (b) inconsistency in the range of response options across studies.

Depressive symptoms

Depressive symptoms were assessed with the 15-item GDS (GDS-15; Sheikh & Yesavage, 1986) in EAS, the 10-item version of the Center for Epidemiological Studies-Depression (CES-D) scale (Radloff, 1977) in MAP/MARS, the 8-item version of the CES-D scale (Radloff, 1977) in HRS, and the Patient Health Questionnaire-2 (PHQ-2; Kroenke et al., 2003) in NHATS. Due to its overlap with self-reported memory impairment, one item ("Do you feel you have more problems with memory than most?") was eliminated from the GDS final score. Response options for

the GDS and CES-D were dichotomous (1 = *yes*; 0 = *no*) while the PHQ-2 used a 4-point scale for response options (1 = *not at all*, 2 = *several*, 3 = *more than half the days*, and 4 = *nearly every day*). Higher scores across measures indicate more depressive symptoms. Scores ranged from 0 to 14 for the revised GDS in EAS, 0 to 10 for the CES-D in MAP/MARS, 0 to 8 for the CES-D in HRS, and 2 to 8 for the PHQ-2 in NHATS. All measures of depressive symptoms had moderate to good reliability (GDS: 0.88; CES-D [10-item]: 0.85; CES-D [8-item]: 0.79; PHQ-2: 0.77).

Personality

Neuroticism, conscientiousness, and extraversion were examined using the 50-item International Personality Pool questionnaire (Lim & Ployhart, 2006) in EAS, the 26-item Midlife Development Inventory (MIDI; Lachman & Weaver, 1997) in HRS, and the 10-item version of MIDI (Lachman & Weaver, 1997) in NHATS. Of the three traits, only neuroticism was available across both MAP/MARS, where it was assessed using a 12-item version of NEO Five-Factor Inventory (Costa & McCrae, 1992). Across data sets, response options were reverse-coded as needed such that higher scores represent higher self-ratings of neuroticism, conscientiousness, and extraversion. All items and response options (original and recoded, where applicable) from each data set are provided in Supplementary Table 2.

Covariates

Participants' age, sex (0 = *male*; 1 = *female*), race (0 = *White/non-Hispanic*; 1 = *Black/non-Hispanic*), education, and income were included as covariates. Additionally, for the HRS data set, cohort was included as a covariate (1 = *born before 1924*; 2 = *children of the depression: born between 1924 and 1930*; 3 = *born between 1931 and 1941*; 4 = *war babies: born between 1942 and 1947*). Across data sets, education and income were recoded into similar categorical variables (education: 1 = *less than high school*; 2 = *high school*; 3 = *post-secondary education/associate degree*; 4 = *bachelor's or higher*; income: 1 = *<$15K*, 2 = *$15K–$30K*, 3 = *>$30K*) to perform coordinated analyses. Age was available as a continuous variable in EAS, HRS, and MAP/MARS. In NHATS, a categorical variable for age is available with six categories (1 = *65–69*; 2 = *70–74*; 3 = *75–79*; 4 = *80–84*; 5 = *85–89*; 6 = *90+*). The large number of age categories in NHATS allowed us to treat age as a continuous variable across all models.

Statistical Analysis

First, descriptive statistics and correlations among key study variables were examined. Next, using SAS (v.9), multilevel linear modeling analyses were performed to examine longitudinal associations among self-reported memory impairment, personality, and depressive symptoms. First, empty models were used to calculate the intraclass correlation coefficient to examine the percentage of variance in depressive symptoms that could be attributed to change within-persons over time. We then fit unconditional growth models to examine the trajectory of depressive symptoms in older adults. Next, conditional growth models examined the within-person associations of self-reported memory impairment with depressive symptoms, after accounting for the between-person associations of these variables. Personality traits were included as time-invariate main effects and their cross-level interactions were tested to determine how traits moderate these associations. Predictor and moderator variables were grand-mean-centered to create meaningful zero points for coefficient interpretations. Current memory problem frequency and current memory ratings were centered at baseline to examine how within-person changes in these variables relate to changes in depressive symptoms (Sliwinski & Buschke, 1999). Perceived memory decline was included as a raw variable because the zero point was meaningful within individuals. Time, sex, race, age, education, income, and cohort (HRS only) were included as covariates. Due to large sample sizes, we set our criterion significance value at $p < .01$. Effect size is measured using pseudo-R^2 (Hoffman, 2015). Pseudo-R^2 provides a metric for the proportion of variance reduced across levels in our model as additional predictors are included. For our models, we examined incremental pseudo-R^2 for our final models relative to a covariates-only model.

Results

Descriptive Analyses

Examination of the empty models indicated that between 36.02% (EAS) and 54.82% (NHATS) of the variance in depressive symptoms was due to changes within individuals over time. Older adults' reports of depressive symptoms increased over time across all data sets (EAS: $b = 0.028$, $SE = 0.010$, $p < .01$; MAP/MARS: $b = 0.018$, $SE = 0.004$, $p < .001$; HRS: $b = 0.032$, $SE = 0.003$, $p < .001$; NHATS: $b = 0.018$, $SE = 0.004$, $p < .001$).

Current Memory Problem Frequency (EAS and MAP/MARS)/Rating (HRS and NHATS) and Depressive Symptoms

The within-person association of current memory problem frequency with depressive symptoms was not significant (EAS: $b = -0.096$, $SE = 0.053$, $p = .068$; MAP/MARS: $b = 0.058$, $SE = 0.024$, $p = .015$; see Table 2, columns 1 and 2) and was not moderated by personality (see Author Note 1). However, the within-person association of current memory rating with depressive symptoms was significant, such that, at times when individuals reported poorer current memory ratings, they also reported more depressive symptoms (HRS: $b = 0.128$,

Table 2. Personality as the Moderator of the Within-Person Association of Current Memory Functioning and Depressive Symptoms Accounting for Between-Person Differences

	EAS	MAP/MARS	HRS	NHATS
Outcome: depressive symptoms	*b* (*SE*)	*b* (*SE*)	*b* (*SE*)	*b* (*SE*)
Intercept	1.554*** (0.129)	1.015*** (0.075)	1.151*** (0.029)	2.922*** (0.074)
Time	0.031** (0.011)	0.014** (0.005)	0.026*** (0.003)	0.013** (0.004)
Within-person				
Current memory functioning (CMF)	−0.096 (0.053)	0.058 (0.024)	0.128*** (0.013)	0.094*** (0.015)
CMF * Neuroticism	—	—	0.028*** (0.005)	0.030*** (0.008)
CMF * Conscientiousness	—	NA	—	—
CMF * Extraversion	—	NA	−0.015*** (0.004)	—
Between-person				
Current memory functioning (CMF)	−0.062 (0.095)	0.111** (0.043)	0.162*** (0.018)	0.187*** (0.022)
Neuroticism	0.102*** (0.011)	0.078*** (0.005)	0.190*** (0.007)	0.172*** (0.011)
Conscientiousness	−0.036** (0.011)	NA	−0.028*** (0.007)	−0.086*** (0.014)
Extraversion	−0.018 (0.010)	NA	−0.041*** (0.006)	−0.046*** (0.013)
CMF * Neuroticism	—		0.052*** (0.007)	0.039** (0.012)
CMF * Conscientiousness		NA	—	—
CMF * Extraversion	—	NA	—	—
Covariates				
Sex (ref = female)	−0.009 (0.134)	−0.185 (0.086)	−0.248*** (0.031)	−0.078 (0.038)
Education	0.034 (0.065)	0.014 (0.042)	−0.062*** (0.015)	−0.099*** (0.018)
Age	0.025 (0.013)	0.003 (0.006)	−0.008 (0.008)	0.020 (0.013)
Black (ref = White)	0.130 (0.148)	0.161 (0.082)	0.113 (0.058)	0.222*** (0.048)
Income	−0.168 (0.098)	−0.178** (0.056)	−0.230*** (0.025)	−0.005 (0.021)
Pseudo-R^2	0.213	0.132	0.128	0.120

Notes: EAS, MAP/MARS, NHATS, and HRS data sets were analyzed separately. Results are presented together for ease of comparison. Cohort was also included as a covariate in HRS analyses; its association with depressive symptoms was not significant. CMF was measured as current memory problem frequency in EAS and MAP/MARS and current memory rating in HRS and NHATS. Only significant interactions were included in the final models (— represents nonsignificant interactions that were not included in the final model). NA = not available: conscientiousness and extraversion measures were not available in MAP/MARS data set. Pseudo-R^2 represents the proportion of variance reduced across levels by predictors after accounting for covariates. EAS = Einstein Aging Study; HRS = Health and Retirement Study; MAP = Memory and Aging Project; MARS = Minority Aging Research Study; NHATS = National Health and Aging Trends Study.
***$p < .001$. **$p < .01$.

SE = 0.013, $p < .001$; NHATS: *b* = 0.094, *SE* = 0.015, $p < .001$; see Table 2, columns 3 and 4). In HRS, this association was moderated by neuroticism (*b* = 0.028, *SE* = 0.005, $p < .001$) and extraversion (*b* = −0.015, *SE* = 0.004, $p < .001$). Simple slopes tests indicated relationships were stronger for individuals with higher (+1 *SD*) levels of neuroticism (*b* = 0.193, *SE* = 0.018, $p < .001$; vs lower: *b* = 0.062, *SE* = 0.017, $p < .001$) or lower (−1 *SD*) levels of extraversion (*b* = 0.168, *SE* = 0.017, $p < .001$; vs higher: *b* = 0.086, *SE* = 0.018, $p < .001$). In NHATS, this association was moderated by neuroticism (*b* = 0.030, *SE* = 0.008, $p < .001$). Simple slopes tests indicated a significant slope for individuals with higher (*b* = 0.142, *SE* = 0.020, $p < .001$) but not lower levels of neuroticism (*b* = 0.046, *SE* = 0.020, *p* = .024).

Perceived 1- (EAS and NHATS), 2- (HRS), and 10-Year (EAS and MAP/MARS) Memory Decline and Depressive Symptoms

The within-person associations of perceived 1- and 2-year memory decline with depressive symptoms were significant, such that, at times when older adults perceived a decline in their memory from the previous wave, they reported more depressive symptoms (EAS: *b* = 0.218, *SE* = 0.076, $p < .01$; HRS: *b* = 0.302, *SE* = 0.021, $p < .001$; NHATS: *b* = 0.242, *SE* = 0.033, $p < .001$; see Table 3) and this relationship was moderated by neuroticism in NHATS (*b* = 0.087, *SE* = 0.018, $p < .001$). Simple slopes indicated a significant slope for individuals with higher levels of neuroticism (*b* = 0.385, *SE* = 0.039, $p < .001$) but not lower (*b* = 0.100, *SE* = 0.050, *p* = .044). In HRS, the within-person relationship was moderated by neuroticism (*b* = 0.073, *SE* = 0.009, $p < .001$) and extraversion (*b* = −0.023, *SE* = 0.007, $p < .01$). Simple slopes indicated relationships were stronger for individuals with higher neuroticism (*b* = 0.473, *SE* = 0.029, $p < .001$; vs lower: *b* = 0.130, *SE* = 0.030, $p < .001$) or lower extraversion (*b* = 0.366, *SE* = 0.028, $p < .001$; vs higher: *b* = 0.237, *SE* = 0.031, $p < .001$).

Within-person association of perceived 10-year memory decline with depressive symptoms was significant, such that, at times when individuals perceived 10-year memory decline they reported more depressive symptoms in MAP/MARS (*b* = 0.119, *SE* = 0.046, $p < .01$; see Table 4, column

Table 3. Personality as the Moderator of the Within-Person Association of Perceived 1- or 2-Year Memory Decline and Depressive Symptoms Accounting for Between-Person Differences

	EAS	HRS	NHATS
Outcome: depressive symptoms	*b* (*SE*)	*b* (*SE*)	*b* (*SE*)
Intercept	1.560*** (0.120)	1.117*** (0.029)	2.967*** (0.074)
Time	0.026 (0.010)	0.026*** (0.003)	0.016*** (0.004)
Within-person			
Perceived 1-/2-year memory decline (PMD)	0.218** (0.076)	0.302*** (0.021)	0.242*** (0.033)
PMD * Neuroticism	—	0.073*** (0.009)	0.087*** (0.018)
PMD * Conscientiousness	—	—	—
PMD * Extraversion	—	−0.023** (0.007)	—
Between-person			
Perceived 1-/2-year memory decline (PMD)	0.549** (0.179)	0.218*** (0.040)	0.238*** (0.064)
Neuroticism	0.087*** (0.010)	0.171*** (0.007)	0.169*** (0.011)
Conscientiousness	−0.034*** (0.010)	−0.030*** (0.007)	−0.096*** (0.014)
Extraversion	−0.009 (0.010)	−0.040*** (0.006)	−0.054*** (0.013)
PMD * Neuroticism	0.130*** (0.024)	—	—
PMD * Conscientiousness	—	—	—
PMD * Extraversion	—	—	—
Covariates			
Sex (ref = male)	−0.034 (0.122)	−0.237*** (0.031)	−0.070 (0.038)
Education	−0.018 (0.060)	−0.085*** (0.015)	−0.124*** (0.018)
Age	0.026 (0.012)	−0.008 (0.007)	0.017 (0.013)
Black (ref = White)	0.081 (0.135)	0.143 (0.057)	0.271*** (0.048)
Income	−0.204 (0.091)	−0.235*** (0.024)	−0.004 (0.020)
Pseudo-R^2	0.292	0.137	0.124

Notes: EAS, HRS, and NHATS data sets were analyzed separately. MAP/MARS data set did not examine perceived 1-year memory decline. Results are presented together for ease of comparison. Cohort was also included as a covariate in HRS analyses; its association with depressive symptoms was not significant. Only significant interactions were included in the final models (— represents nonsignificant interactions that were not included in the final model). Pseudo-R^2 represents the proportion of variance reduced across levels by predictors after accounting for covariates. EAS = Einstein Aging Study; HRS = Health and Retirement Study; MAP = Memory and Aging Project; MARS = Minority Aging Research Study; NHATS = National Health and Aging Trends Study.
***$p < .001$. **$p < .01$.

2) and this association was moderated by neuroticism ($b = 0.016$, $SE = 0.006$, $p < .01$). Simple slopes tests indicated a significant slope for individuals with higher levels of neuroticism ($b = 0.226$, $SE = 0.064$, $p < .001$), and not lower ($b = 0.012$, $SE = 0.059$, $p = .844$).

Discussion

The current paper examined within-person associations of self-reports of memory impairment and depressive symptoms in older adults without cognitive impairment, and whether these associations were moderated by neuroticism, conscientiousness, or extraversion. Using a coordinated analytic approach, we found substantial support for our first hypothesis (H1). Across data sets, greater self-reported memory impairment was related to greater depressive symptoms across time for perceived memory decline since the last assessment, in line with previous work (Bhang et al., 2020; Mogle et al., 2020). However, in our examination of personality traits as a moderator of these associations (H2), there was decidedly less consistency. Within-person moderation by personality was only consistently identified for neuroticism and was most frequently found in the largest of our data sets (NHATS and HRS). We discuss the implications of these results below.

At the within-person level, self-reports of memory impairment were associated with greater depressive symptoms (H1), but only when items tapped into perceived decline in memory over shorter time intervals (i.e., 1–2 years). This provides evidence for our hypothesis that perceived memory decline would have stronger associations with depressive symptoms compared with reports of current memory functioning (H3). Additionally, this supports longitudinal work on the impact of perceiving recent and ongoing declines in memory on the emotional well-being of older adults. For example, Roehr et al. (2017) found that perceived memory decline ("Do you feel your memory is worsening?") was associated with persistently lower levels of health-related quality of life, while Castro-Lionard et al. (2011) reported a negative association between perceived 5-year memory decline and life satisfaction measured 6 years later. In contrast, the item in our study assessing perceived change in

Table 4. Personality as the Moderator of the Within-Person Association of Perceived 10-Year Memory Decline and Depressive Symptoms Accounting for Between-Person Differences

	EAS	MAP/MARS
Outcome: depressive symptoms	*b* (*SE*)	*b* (*SE*)
Intercept	1.500*** (0.133)	0.916*** (0.082)
Time	0.027** (0.010)	0.015** (0.005)
Within-person		
Perceived 10-year memory decline (PMD)	0.082 (0.071)	0.119** (0.046)
PMD * Neuroticism	—	0.016** (0.006)
PMD * Conscientiousness	—	NA
PMD * Extraversion	—	NA
Between-person		
Perceived 10-year memory decline (PMD)	0.199 (0.132)	−0.155 (0.086)
Neuroticism	0.093*** (0.011)	0.069*** (0.007)
Conscientiousness	−0.038*** (0.011)	NA
Extraversion	−0.014 (0.010)	NA
PMD * Neuroticism	0.081*** (0.020)	
PMD * Conscientiousness	—	NA
PMD * Extraversion	—	NA
Covariates		
Sex (ref = male)	0.008 (0.130)	−0.193 (0.086)
Education	0.024 (0.063)	0.011 (0.043)
Age	0.026 (0.013)	0.004 (0.006)
Black (ref = White)	0.107 (0.143)	0.185 (0.083)
Income	−0.204 (0.097)	−0.169** (0.056)
Pseudo-R^2	0.242	0.149

Notes: EAS and MAP/MARS data sets were analyzed separately. HRS and NHATS data set did not examine perceived 10-year memory decline. Results are presented together for ease of comparison. Only significant interactions were included in the final models (— represents nonsignificant interactions that were not included in the final model). NA = not applicable: conscientiousness and extraversion measures were not available in MAP/MARS data set. Pseudo-R^2 represents the proportion of variance reduced across levels by predictors after accounting for covariates. EAS = Einstein Aging Study; HRS = Health and Retirement Study; MAP = Memory and Aging Project; MARS = Minority Aging Research Study; NHATS = National Health and Aging Trends Study.
***$p < .001$. **$p < .01$.

memory over 10 years was inconsistently related to depressive symptoms (H3). The contrast of these findings suggests that declines in memory that are perceived as dispersed over longer (mental) time frames may be less troubling to older adults. Indeed, declines in memory that are perceived as part of normal aging are typically rated as less upsetting (Parikh et al., 2016). However, this item was only available in two of our data sets and additional work is needed to understand the potential implications of assessing memory decline over longer versus shorter periods of reflection.

Consistent with previous work relating neuroticism to self-reported memory impairment and depressive symptoms, neuroticism strengthened the relationship between memory impairment and depressive symptoms over time (H2). This suggests that individuals higher in neuroticism will experience greater depressive symptoms as they perceive declines in their memory functioning, even when those declines are part of normal aging. Tailoring health promotion interventions for certain groups based on personality traits has been effective in other contexts, such as smoking cessation (Chapman et al., 2014). Therefore, poor memory perceptions in persons with higher neuroticism may indicate a greater need for targeted psychosocial interventions. However, as some work indicates that neuroticism declines within individuals across time (Yoneda et al., 2017), it is important to note that our finding is specific to personality levels earlier in the aging trajectory. Whether this relationship holds as individuals age or in the face of nonnormative memory decline remains unclear. Interestingly, relationships among neuroticism, self-reported memory impairment, and depressive symptoms were generally small and only achieved significance in our largest data sets. There are several possibilities for this inconsistency across studies. By virtue of their size and sampling frame, more interindividual variability in neuroticism is represented in NHATS and HRS compared to EAS and MARS/MAP. That is, these studies are able to capture broader ranges of individuals and therefore a broader range of personality characteristics in general, and (perhaps) neuroticism specifically. Another possibility is that the influence of neuroticism is relatively small and will only be consistently significant at

the traditional criteria in larger data sets. However, this work does suggest neuroticism is an important variable in the longitudinal associations.

Less clear are our inconsistent findings with extraversion (H2; Luchetti et al., 2016; Studer et al., 2014). In the HRS sample, we found that higher levels of extraversion weakened the relationship between reports of memory impairment and depressive symptoms over time. That is, individuals with higher extraversion were less likely to experience increases in depressive symptoms when they reported greater memory impairment. This suggests a potential protective effect of higher levels of extraversion in individuals experiencing normative memory aging (Baek et al., 2016), consistent with previous work (Hülür et al., 2015; Yoon et al., 2019). However, these effects were only identified in one data set in the current study; therefore, more examination is needed. As with neuroticism, the inconsistencies across data sets in our study could arise from a small or nominally nonexistent relationship or from HRS achieving a wider, more representative sample of extraversion in older adults. Contrary to hypotheses, we did not find any evidence of moderation for conscientiousness (H2). However, this is consistent with a recent literature review that found limited evidence for the role of conscientiousness in reports of memory impairment among older adults (Koller et al., 2019).

There are several limitations to consider in the current study. First, as a secondary data analysis, we were limited to certain measures that were included in the parent studies for purposes other than the current analyses. For example, the self-reported memory impairment assessments used here do not reflect the wide variety of possible items, and our results are limited to these aspects. Second, the assessments of depressive symptoms and personality in NHATS were very brief (i.e., 2-item), which limit the reliability and construct coverage of these measures. However, the PHQ-2 shows strong psychometric properties and good convergent validity with other established depressive symptoms scales (Staples et al., 2019). Additionally, only non-Hispanic Black and White older adults were included in the current study as older adults from other ethnic groups (e.g., Hispanic, Asian) were not well represented in the data sets. Including them in our sample could have resulted in minimal contributions to the overall model which, in turn, might lead to overgeneralization of findings. Although we included some studies with a greater percentage of Black older adults than much previous research, our samples were still predominantly White. Additional work is needed to examine the generalizability of our results to groups with other racial identities.

Despite these limitations, the current study had several strengths. First, we were able to use data from five longitudinal studies, including two national data sets that represented a variety of backgrounds and geographic locations, enhancing generalizability. Additionally, using four data sets allowed us to immediately replicate analyses of associations of self-reported memory impairment, personality, and depressive symptoms to determine whether conclusions were consistent across at least two samples for a given association. Where results were inconsistent, further research can be directed to determine whether factors such as demographic or measurement differences contributed to these results.

Conclusion

The current study used a coordinated analysis framework across four large longitudinal data sets to examine within-person associations between self-reported memory impairment and depressive symptoms in older adults without cognitive impairment, and whether personality moderated these associations. Across samples, self-reported memory impairment covaried with depressive symptoms over time. Results showed that higher neuroticism consistently strengthened the longitudinal associations between self-reported memory impairment and depressive symptoms in the two largest data sets. Neuroticism may play a role in the extent to which older adults' psychological well-being is affected at times when they experience memory problems. Further research is needed to refine understanding of the moderating role of personality on longitudinal associations between perceived memory impairment and psychological well-being in older adults without cognitive impairment.

Supplementary Material

Supplementary data are available at *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences* online.

Author Note

1. Our primary substantive analyses focused on extraversion, neuroticism, and conscientiousness; however, exploratory models were fit using all five personality traits. Openness and agreeableness did not show consistent relationships across data sets and including these traits did not substantively affect conclusions. The results of these models are available in Supplementary Tables 5–7.

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Conflict of Interest

None declared.

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