Research Article

Psychological Science
2020, Vol. 31(11) 1386–1395

DOI: 10.1177/0956797620953883
www.psychologicalscience.org/PS
SAGE

Positive Affect Is Associated With Less Memory Decline: Evidence From a 9-Year Longitudinal Study

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Abstract

Memory decline is a concern for aging populations across the globe. Positive affect plays an important role in healthy aging, but its link with memory decline has remained unclear. In the present study, we examined associations between positive affect (i.e., feeling enthusiastic, attentive, proud, active) and memory (i.e., immediate and delayed recall), drawing from a 9-year longitudinal study of a national sample of 991 middle-age and older U.S. adults. Results revealed that positive affect was associated with less memory decline across 9 years when analyses controlled for age, gender, education, depression, negative affect, and extraversion. Findings generalized across another measure that assessed additional facets of positive affect, across different (but not all) facets of positive affect and memory, and across age, gender, and education; findings did not emerge for negative affect. Reverse longitudinal associations between memory and positive affect were not significant. Possible pathways linking positive affect and memory functioning are discussed.

Keywords

positive affect, memory, cognitive aging, Midlife in the United States (MIDUS), open data

Received 8/23/18; Revision accepted 5/28/20

Many adults are at risk for cognitive decline as they age (Hughes, Agrigoroaei, Jeon, Bruzzese, & Lachman, 2018; Salthouse, 2004). Memory decline in particular is common in normative aging (Buckner, 2004) and represents one of the earliest manifestations of Alzheimer's disease. Studies have uncovered modifiable factors that presumably buffer memory decline, including physical and cognitive activity (Plassman, 2010). Yet despite the role that positive affect plays in physical health (Pressman, Jenkins, & Moskowitz, 2019) and healthy aging (Carstensen, Isaacowitz, & Charles, 1999; Ong, 2010), we know surprisingly little about whether positive affect can protect against memory decline. The present study examined associations between positive affect and memory in a 9-year longitudinal study of a large national sample of middle-age and older adults in the United States.

Pathways From Positive Affect to Memory

Positive affect refers to the subjective experience of pleasant affective states, such as enthusiasm or joy, over shorter and longer time intervals (Pressman & Cross, 2018; Watson, Wiese, Vaidya, & Tellegen, 1999). It is conceptually and empirically distinct from negative affect (Watson et al., 1999) and other aspects of well-being (e.g., life satisfaction; Diener, 2000).

Positive affect may benefit memory functioning (cf. Ong, 2010; Pressman et al., 2019) through several pathways,

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including physiological, behavioral, and social channels. Regarding physiological pathways, positive affect has been linked to more adaptive cardiovascular functioning (e.g., faster recovery from cardiovascular effects associated with negative emotion; Fredrickson & Levenson, 1998) and immune functioning (e.g., reduced fibrinogen response; Steptoe, Wardle, & Marmot, 2005). For behavioral pathways, positive affect has been associated with more adaptive health behaviors (e.g., physical activity; Sin, Moskowitz, & Whooley, 2015). In terms of social pathways, positive affect has been linked to better social relationships (e.g., Lyubomirsky, King, & Diener, 2005). A sizable body of research, in turn, has found that physiological, behavioral, and social-engagement factors can reduce the risk of cognitive decline (Baumgart et al., 2015).

Despite these documented pathways, long-term associations between positive affect and memory remain unclear. Some longitudinal studies indeed show that higher positive affect is associated with fewer subjective memory complaints (Lee, 2016), that higher well-being is linked with less decline in perceptual speed (Gerstorf, Lövdén, Röcke, Smith, & Lindenberger, 2007) and better memory (Allerhand, Gale, & Deary, 2014), and that increases in positive affect are associated with increases in memory (Castro-Schilo, Fredrickson, & Mungas, 2019). However, other longitudinal studies have found no associations between positive affect and memory decline (Berk, van Boxtel, Köhler, & van Os, 2017; Brailean et al., 2016). These studies provide important insights, but they have not always used gold-standard measures of positive affect (Pressman & Cross, 2018), objective measures of memory functioning, or sample sizes that afforded sufficient statistical power to detect small effects.

The Present Study

In the present study, we examined longitudinal associations between positive affect (i.e., feeling enthusiastic, attentive, proud, and active during the previous 30 days; Watson, Clark, & Tellegen, 1988) and memory functioning (i.e., immediate- and delayed-recall performance; Lachman, Agrigoroaei, Tun, & Weaver, 2014) over 9 years using data from a large-scale national sample of middle-age and older adults in the United States. Drawing from prior research that shows cognitive benefits of positive affect and well-being (Allerhand et al., 2014; Castro-Schilo et al., 2019; Gerstorf et al., 2007; Lee, 2016), we hypothesized that higher levels of positive affect would be associated with higher levels of memory 9 years later, accounting for baseline memory. Thus, we hypothesized that positive affect would be associated with less memory decline over time. Considering the well-documented age differences in memory and positive affect (Berk et al., 2017; Brailean et al., 2016; Gerstorf et al., 2007), we controlled for age as well as other covariates known to be linked to positive affect or memory (gender, education, depression, negative affect, and extraversion). Primary analyses examined a gold-standard measure of positive affect (cf. Watson et al., 1988). Follow-up analyses examined robustness, specificity, generalizability, and directionality of the findings.

Method

We analyzed 18-year longitudinal data from the national Midlife in the United States (MIDUS) study conducted from 1995 to 1996 (Time 1), 2004 to 2006 (Time 2), and 2013 to 2014 (Time 3), with memory data spanning a 9-year interval between Time 2 and Time 3. A detailed description of the MIDUS study can be found online (http://midus.wisc.edu/scopeofstudy.php).

Participants and procedure

A national sample of households in the 48 contiguous U.S. states with at least one telephone was selected using random digit dialing. The present study focused on the MIDUS core sample (i.e., noninstitutionalized adults; most participants were between 40 and 60 years of age). At Time 1, 7,120 participants reported on their positive affect using a measure that combined items from the Affect Balance Scale (ABS; Bradburn, 1969) and the General Well-Being Schedule (GWB; Fazio, 1977). At Time 2 (9 years later), 75% of the Time 1 sample (n = 4,955) reported on their positive affect using the ABS-GWB measure and an abbreviated version of the Positive Affect subscale of the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988); they also completed a memory assessment. At Time 3 (9 years later), 77% (n = 3,294) of the Time 2 sample again reported on their positive affect and completed a memory assessment.

The present analyses examined associations between positive affect and changes in memory functioning over time. To test longitudinal associations, we conducted rank-order analyses focused on associations between memory at Time 3 and positive affect (PANAS) at Time 2, above and beyond baseline memory at Time 2. Robustness tests also included positive affect (ABS-GWB), averaged across Times 1 and 2 to provide a more robust estimate (following recommendations by Pressman & Cross, 2018).[1] Thus, analyses were run on participants who had complete data for positive affect (PANAS) at Time 2, positive affect (ABS-GWB) at Time 1 and Time 2, memory at Time 2 and Time 3, and all covariates at Time 2. This sample consisted of 991 participants (age at Time 2: M = 55.53 years, SD = 11.36, range = 34–83; 54.5% female; 91.7% White). Participants included in

Table 1. Descriptive Statistics for the Analysis Sample

Variable	*M*	*SD*	Minimum	Maximum
Positive affect (PANAS; Time 2)	3.61	0.74	1.00	5.00
Positive affect (PANAS; Time 3)	3.54	0.79	1.00	5.00
Positive affect (ABS-GWB; Time 1)	3.40	0.69	1.00	5.00
Positive affect (ABS-GWB; Time 2)	3.44	0.69	1.00	5.00
Positive affect (ABS-GWB; Time 3)	3.42	0.71	1.00	5.00
Memory (Time 2)	0.08	0.98	−2.42	3.60
Memory (Time 3)	−0.08	1.03	−3.07	3.17
Age (years; Time 2)	55.53	11.36	34.00	83.00
Years of education (Time 2)	7.57	2.55	1.00	12.00
Depression (Time 2)	0.09	0.28	0.00	1.00
Negative affect (PANAS; Time 2)	1.53	0.48	1.00	4.60
Negative affect (ABS-GWB; Time 1)	1.54	0.59	1.00	4.83
Negative affect (ABS-GWB; Time 2)	1.49	0.53	1.00	4.83
Extraversion (Time 2)	3.13	0.57	1.20	4.00

Note: The proportion of the sample that was female at Time 2 was .55 (SD = .50). Memory scores at Time 3 were standardized following established Midlife in the United States (MIDUS) protocol (see Hughes, Agrigoroaei, Jeon, Bruzzese, & Lachman, 2018). PANAS = Positive and Negative Affect Schedule; ABS-GWB = Affect Balance Scale-General Well-Being Schedule.

the present study differed from those core Time 2 sample participants who were not included in that they exhibited higher levels of positive affect (PANAS), $t(1787) = 2.89$, $p = .004$; positive affect (ABS-GWB), $t(1787) = 2.54$, $p = .011$; memory, $t(1853) = 5.73$, $p < .001$; and education, $t(2253) = 7.61$, $p < .001$; and lower levels of negative affect, $t(1777) = -2.78$, $p = .006$. On the basis of prior research (Allerhand et al., 2014; Gerstorf et al., 2007; Lee, 2016), we expected a small effect of positive affect on memory changes, and analyses using G*Power (Version 3.1; Faul, Erdfelder, Buchner, & Lang, 2009) showed that the sample size (N = 991) allowed for detecting a small effect (f^2 = .02) at an alpha level of .05 with statistical power of .99.

Measures

Descriptive statistics are presented in Table 1.

Positive affect. Positive affect was assessed using two measures. First, positive affect (PANAS) was measured using an abbreviated four-item version of the Positive Affect subscale of the PANAS (Watson et al., 1988). Participants were asked, “During the past 30 days, how much of the time did you feel . . .” (a) “enthusiastic,” (b) “attentive,” (c) “proud,” and (d) “active”? Answers were reverse-scored on a scale ranging from 1, *none of the time*, to 5, *all of the time*—Time 2: α = .86, skewness = −.54 (SE = .08), kurtosis = .46 (SE = .16); Time 3: α = .86, skewness = −.54 (SE = .08), kurtosis = .34 (SE = .16). Second, positive affect (ABS-GWB) was assessed using a measure that has been used in prior research (Mroczek & Kolarz, 1998) combining six items from the ABS (Bradburn, 1969) and the GWB (Fazio, 1977). Participants were asked, “During the past 30 days, how much of the time did you feel . . .” (a) “cheerful,” (b) “in good spirits,” (c) “extremely happy,” (d) “calm and peaceful,” (e) “satisfied,” and (f) “full of life”? Answers were reverse-scored on a scale ranging from 1, *none of the time*, to 5, *all of the time*—Time 1: α = .91, skewness = −.66 (SE = .08), kurtosis = .47 (SE = .16); Time 2: α = .90, skewness = −.64 (SE = .08), kurtosis = .58 (SE = .16); Time 3: α = .91, skewness = −.65 (SE = .08), kurtosis = .51 (SE = .16).

Memory. Memory was measured as part of the 20-min Brief Test of Adult Cognition by Telephone (BTACT; Lachman et al., 2014), which has shown reliability in previous studies (Lachman et al., 2014). The BTACT is composed of seven cognitive tests, including two memory tests (i.e., immediate and delayed free recall), which were averaged as in previous research (Lachman et al., 2014). Participants were read a list of 15 unrelated words, with a 1-s pause between each word. Each word was read once, and participants were instructed that words would not be repeated. They were then given 90 s to produce as many words in any order from the list as possible immediately (i.e., immediate recall) and after 15 min (i.e., delayed recall).[2] Participants were not warned about the delayed-recall task. There was no feedback given for correct responses, repetitions, or errors. Correct responses, out of a possible total of 15, were recorded for each trial. A memory factor score was created by standardizing the two trials and computing the average. The same list of words was used at Time 2 and Time 3. Existing research has documented a decline in memory from Time 2 to Time 3 with substantial interindividual and intraindividual variation (Hughes et al., 2018). Time 2 means and standard deviations were used to *z*-standardize memory scores at Time 2 and Time 3 to allow for examination of cognitive decline over time, following established procedures (see Hughes et al., 2018).

Covariates. Covariates were age (as a continuous variable), gender (1 = identifying as female, 0 = identifying as male), education (i.e., "What is the highest grade of school or year of college you completed?"; 1 = *No school/some grade school*, 12 = *Ph.D, Ed.D, MD, . . . or other professional degree*), depression, negative affect, and extraversion at Time 2 (plus the other four Big Five personality traits in follow-up analyses). Depression was measured during clinical telephone interviews on the basis of criteria from the *Diagnostic and Statistical Manual of Mental Disorders* (third edition, revised; American Psychiatric Association, 1987). Responses were coded 1 if participants reported feeling sad or depressed "all day long" or "most of the time," reported that the feeling occurred "every day" or "almost every day," and ranked more than four depressive symptoms (e.g., "During two weeks in the past 12 months, when you felt sad, blue, or depressed, did you feel down on yourself, no good, or worthless?"). All other responses were coded 0. Negative affect (PANAS) was measured using an abbreviated five-item version of the Negative Affect PANAS subscale. Participants were asked, "During the past 30 days, how much of the time did you feel . . ." (a) "afraid," (b) "jittery," (c) "irritable," (d) "ashamed," (e) "upset"? Answers were made on a scale from 1, *none of the time*, to 5, *all of the time*—Time 2: α = .80, Time 3 α = .80. Negative affect (ABS-GWB) was measured by six items. Participants read, "During the past 30 days, how much did you feel . . ." (a) "so sad nothing could cheer you up," (b) "nervous," (c) "restless or fidgety," (d) "hopeless," (e) "that everything was an effort," and (f) "worthless?" Response were made on a scale from 1, *none of the time*, to 5, *all of the time*—Time 1: α = .87, Time 2: α = .85, Time 3: α = .85. The Big Five personality traits were measured using modified trait lists. Extraversion was assessed with five items (e.g., outgoing; Time 2: α = .77, Time 3: α = .76), neuroticism was assessed with four items (e.g., nervous; Time 2: α = .74, Time 3: α = .71), openness was assessed with seven items (e.g., broad-minded; Time 2: α = .78, Time 3: α = .77), conscientiousness was assessed with five items (e.g., hardworking; Time 2: α = .69, Time 3: α = .67), and agreeableness was assessed with five items (e.g., caring; Time 2: α = .81, Time 3: α = .77). All were reverse-scored on a scale from 1, *not at all*, to 4, *a lot*.

Data analyses

In preliminary analyses, we examined zero-order correlations and partial correlations controlling for age (to demonstrate that it is particularly important to control for age when examining memory decline; e.g., Berk et al., 2017; Brailean et al., 2016; Gerstorf et al., 2007). To test our main hypothesis, we examined whether positive affect (PANAS) is associated with changes in memory using an autoregressive (or residualized-change) approach (Castro-Schilo & Grimm, 2018). This approach allows for estimating how an independent variable (positive affect at Time 2) is related to a dependent variable (memory at Time 3) once the initial level of that variable (memory at Time 2) has been taken into account. This approach allows for examining changes in rank order as opposed to other forms of change (e.g., mean-level change, structural change, ipsative change; see Caspi & Roberts, 1999). Of note, we used time of memory assessment rather than chronological age for our autoregressive time metric in the present study (see Grimm, Ram, & Estabrook, 2017). Time-based modeling (a) increases the statistical power to examine the individual-differences question (i.e., whether positive affect is associated with less memory decline) and (b) is necessitated by the MIDUS study design. Although one of the strengths of MIDUS is that it draws from a very age-diverse sample, memory-functioning data are currently available at two waves of measurement spread over 9 years (with few between-person differences in the length of the time interval of data collection).

Follow-up analyses probed robustness, specificity, generalizability, and directionality. Robustness was probed by testing whether findings remained stable when we examined another measure of positive affect (ABS-GWB) and a measure of memory averaged across Time 2 and Time 3 (cf. Glymour, Weuve, Berkman, Kawachi, & Robins, 2005; Turiano et al., 2012). Specificity was probed by examining those associations using (a) changes in memory and each of the individual items of positive affect as the independent variable in separate models; (b) positive affect (PANAS) and changes in memory controlling for positive affect (ABS-GWB); (c) positive affect and changes in immediate versus delayed recall, each used as the dependent variable in separate models; and (d) negative affect (PANAS/ABS-GWB) and changes in memory. We analyzed generalizability by examining whether age, gender, or education moderated associations between positive affect (PANAS or ABS-GWB) and changes in memory, and we analyzed directionality by examining reverse associations with memory and changes in positive affect (PANAS or ABS-GWB). Analyses controlled for age, gender, education, depression, negative affect (or positive affect, in the specificity

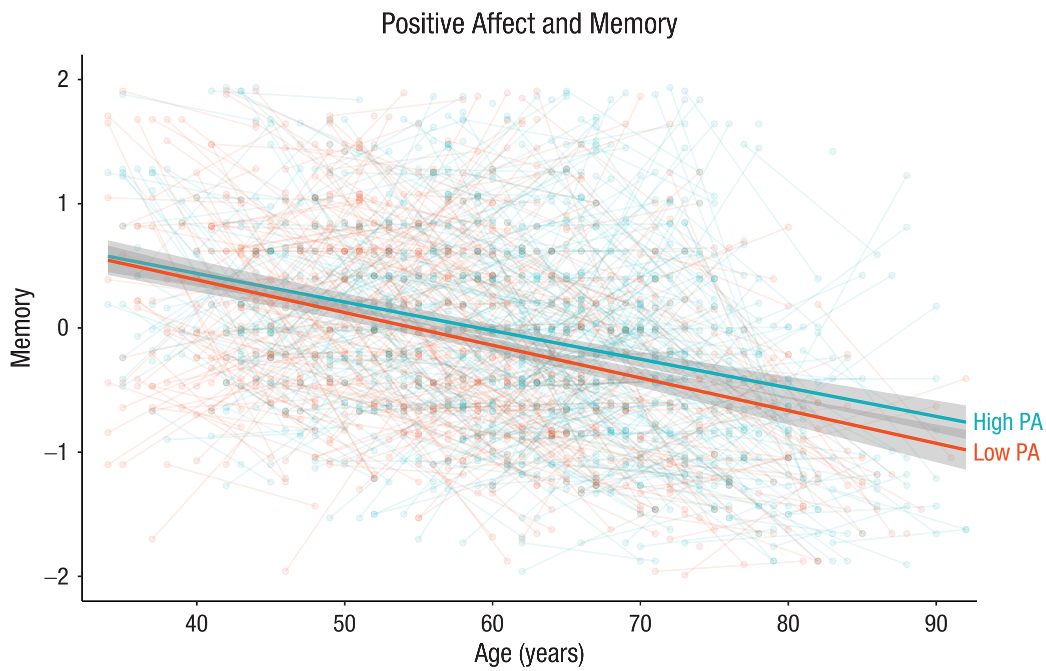

Fig. 1. Scatterplot showing the relation between age and memory as a function of positive affect (PA). Results are shown separately for individuals high (blue) and low (red) in PA (as indexed by the Positive and Negative Affect Schedule and defined by a median split at Time 2). The thick lines show the best-fitting overall linear trends in memory functioning for each group, and the gray bands reflect standard errors. The faint lines connect raw 9-year memory-functioning trajectories from Time 2 to Time 3 for all individuals with memory scores between −2 *SD* and 2 *SD*.

analyses), and extraversion (and all Big Five personality traits in a follow-up analysis).

Finally, a multiverse analysis (Steegen, Tuerlinckx, Gelman, & Vanpaemel, 2016) was performed with the aim of increasing transparency within the data-cleaning and analysis process and to show the extent to which findings remained robust when several reasonable alternative data-processing decisions were made. To do this, we constructed a multiverse of data sets that contained all possible data sets that can arise from different reasonable data-processing decisions. These processing choices included dichotomized versus continuous positive affect (Time 2), dichotomized versus continuous memory (Time 2), the exclusion of participants more than 3 standard deviations from the mean for positive affect (Time 2) and memory (Time 2) versus including all participants, and any combination of covariates (e.g., some models included only one covariate, but others included all six). Positive affect (PANAS) was used throughout the multiverse analyses. This resulted in 576 data sets to be used throughout all of the multiverse analyses. We then analyzed each data set separately to test whether there was a relationship between positive affect and memory (Time 3), accounting for memory (Time 2). We determined what percentage of data sets produced a significant association between positive affect and memory, with a focus on *p* values at a threshold of .05, as in prior research (Steegen et al., 2016).

All analyses used an autoregressive approach. We had converging evidence when using a different analytic approach. Analyses were repeated using a difference-score approach (i.e., Time 3 – Time 2 memory) to measure longitudinal change as in previous studies (Rickenbach, Almeida, Seeman, & Lachman, 2014), and results remained stable (see Table S1 and Table S2 in the Supplemental Material available online).[3]

To account for missing data, we repeated analyses using multiple imputation (using 20 imputations and 200 iterations) for missing positive affect (PANAS or ABS-GWB), memory, and covariates ($N = 2{,}257$). Descriptive statistics for the imputed data were similar to those for the nonimputed data. When imputed data were used, the association between positive affect (PANAS and ABS-GWB) and changes in memory remained stable.

Results

Preliminary analyses

Table S3 in the Supplemental Material shows zero-order intercorrelations and partial correlations controlling for age for study variables. Figure 1 plots memory performance (individual trajectories and overall trends) broken down by positive affect (PANAS) at Time 2. Figure 1 illustrates that (a) memory declines with age, (b) there are higher levels of positive affect with age, and (c) memory exhibits steeper decline among individuals with low positive affect relative to those with high positive affect.

Positive affect and changes in memory

Autoregressive analyses showed that more positive affect (PANAS) was associated with less memory decline over 9 years after controlling for age, gender, education, depression, negative affect (PANAS), and extraversion (β = 0.09, p = .004; see Table 2).[4] Findings remained stable when we also controlled for all Big Five personality traits (β = 0.08, p = .009). Results also remained stable when we used a difference score instead of an autoregressive approach (see Tables S1 and S2).

Follow-up analyses

Robustness. Findings remained stable when we examined positive affect (ABS-GWB) instead of positive affect (PANAS; see Table 3). More positive affect (ABS-GWB) was associated with less memory decline over 9 years when analyses controlled for age, gender, education, depression, negative affect (PANAS), and extraversion (β = 0.07, p = .019). Findings also remained stable when analyses controlled for average memory (averaged across Time 2 and Time 3, in lieu of baseline memory at Time 2) for both positive affect (PANAS; β = 0.04, p = .018) and positive affect (ABS-GWB; β = 0.05, p = .008), all controlling for covariates.

Specificity. To probe specificity, we first examined different facets of positive affect (PANAS and ABS-GWB). Different facets of positive affect were more strongly associated with less memory decline (enthusiasm: β = 0.09, p = .004; pride: β = 0.07, p = .012; cheerful: β = 0.07, p = .022; good spirits: β = 0.07, p = .025; calm/peaceful: β = 0.07, p = .032), whereas others had less strong associations (attention: β = 0.05, p = .077; activity: β = 0.05, p = .081; extremely happy: β = 0.04, p = .136; satisfied: β = 0.05, p = .127; full of life: β = 0.06, p = .062), all when analyses controlled for covariates. Second, with both the PANAS and ABS-GWB measures in the same model, positive affect (PANAS) was significantly associated with less memory decline (β = 0.07, p = .046) when analyses controlled for positive affect (ABS-GWB), which in and of itself no longer was significant (β = 0.06, p = .314) when controlling for covariates.

Third, we examined different facets of memory. In separate analyses, more positive affect (PANAS) was associated with less decline on each immediate-recall task (β = 0.09, p = .005) and delayed-recall task (β = 0.07, p = .037) when controlling for covariates. Positive affect (ABS-GWB) was more strongly related to less decline on immediate recall (β = 0.08, p = .021) compared with delayed recall (β = 0.05, p = .152) when analyses controlled for covariates. Fourth, we examined associations between negative affect (PANAS and ABS-GWB) and memory change. Negative affect (PANAS; β = −0.03, p = .355) and negative affect (ABS-GWB; β = −0.05, p = .084) were not associated with changes in memory when analyses controlled for covariates.

Generalizability. Associations between positive affect (PANAS) and changes in memory were not moderated by age (β = 0.00, p = .597), gender (β = −0.06, p = .361), or education (β = 0.01, p = .450) when analyses controlled for covariates. Similarly, associations for positive affect (ABS-GWB) were not moderated by age, gender, or education (ps > .05). Findings were consistent when using categorical age groups instead of continuous age in the moderation analysis.

Directionality. Reverse associations between memory and changes in positive affect (PANAS: β = −0.02, p = .531;

Table 2. Longitudinal Associations Between Positive Affect (PANAS) and Memory at Time 3

Predictor	b	SE	β	95% CI	t(982)	p
Positive affect (PANAS; Time 2)	0.13	0.04	0.09	[0.04, 0.21]	2.92	.004
Memory (Time 2)	0.45	0.03	0.43	[0.39, 0.51]	15.41	< .001
Age (Time 2)	−0.02	0.00	−0.26	[−0.03, −0.02]	−9.36	< .001
Female gender (Time 2)	0.30	0.06	0.14	[0.19, 0.41]	5.31	< .001
Education (Time 2)	0.06	0.03	0.06	[0.00, 0.11]	2.09	.037
Depression (Time 2)	0.12	0.10	0.03	[−0.08, 0.32]	1.22	.224
Negative affect (PANAS; Time 2)	−0.06	0.06	−0.03	[−0.18, 0.07]	−0.92	.355
Extraversion (Time 2)	−0.06	0.05	−0.03	[−0.16, 0.04]	−1.24	.216

Note: Time 2 was from 2004 to 2006. Time 3 was from 2013 to 2014. PANAS = Positive and Negative Affect Schedule; CI = confidence interval.

Table 3. Longitudinal Associations Between Positive Affect (ASB-GWB) and Memory at Time 3

Predictor	*b*	*SE*	β	95% CI	*t*(982)	*p*
Positive affect (ASB-GWB; Time 2)	0.13	0.05	0.07	[0.02, 0.23]	2.35	.019
Memory (Time 2)	0.45	0.03	0.43	[0.40, 0.51]	15.49	< .001
Age (Time 2)	−0.02	0.00	−0.25	[−0.03, −0.02]	−9.17	< .001
Female gender (Time 2)	0.30	0.06	0.14	[0.19, 0.41]	5.34	< .001
Education (Time 2)	0.06	0.03	0.06	[0.01, 0.12]	2.32	.021
Depression (Time 2)	0.13	0.10	0.04	[−0.07, 0.33]	1.26	.207
Negative affect (PANAS; Time 2)	−0.06	0.07	−0.03	[−0.19, 0.07]	−0.89	.372
Extraversion (Time 2)	−0.04	0.05	−0.02	[−0.14, 0.06]	−0.84	.404

Note: Time 2 was from 2004 to 2006. Time 3 was from 2013 to 2014. ABS-GWB = Affect Balance Scale-General Well-Being Schedule; PANAS = Positive and Negative Affect Schedule; CI = confidence interval.

ABS-GWB: $\beta = -0.03$, $p = .333$) were not significant when analyses controlled for covariates.

Multiverse analysis. There was a significant association ($p < .05$) between positive affect (PANAS; Time 2) and memory (Time 3), when analyses accounted for memory (Time 2) and a combination of covariates, 54% of the time (see Fig. S1 in the Supplemental Material). Mirroring the present analyses, results when age was included in the model revealed a significant association ($p < .05$) between positive affect and memory 100% of the time (Fig. S2 in the Supplemental Material) and a significant association ($p < .01$) 83% of the time.

Discussion

The present study drew from a large-scale U.S. national sample and showed that more positive affect was associated with less memory decline over time in middle-age and older adults. When analyses controlled for age, gender, education, depression, negative affect, and extraversion, findings were robust across two measures of positive affect, generalized across different (but not all) facets of positive affect and different facets of memory, and generalized across age, gender, education. Findings did not emerge for negative affect. Reverse analyses testing whether memory was associated with changes in positive affect were not significant.

Positive affect is associated with less memory decline

Positive affect plays an important role in the lives of older adults. *Socioemotional-selectivity theory* posits that older adults prioritize positive over negative affect as time horizons shrink (Carstensen et al., 1999), and numerous studies support this proposition (e.g., Reed, Chan, & Mikels, 2014). At the same time, memory decline is a key challenge for many older adults. Forgetting the name of an acquaintance, misplacing one's purse, or forgetting to take one's medication can have significant social, financial, and health consequences. Memory decline is also one of the earliest manifestations of Alzheimer's disease, which has devastating consequences for individuals, families, and societies.

The present study connects these two themes of aging and shows that positive affect is associated with less objective memory decline over nearly a decade in middle-age and older adults. These findings converge with those of previous longitudinal studies, which have shown links between positive affect and subjective-memory complaints (Lee, 2016), positive affect and global cognitive ability (Castro-Schilo et al., 2019), well-being and perceptual speed (Gerstorf et al., 2007), and well-being and memory (Allerhand et al., 2014). Our findings also extend the literature on the many benefits of positive affect (e.g., Folkman & Moskowitz, 2000) to include memory functioning. Moreover, the present findings add to the literature on memory decline by showing that positive affect is linked with performance on two widely used recall tasks that are highly sensitive to detecting normative and pathological cognitive decline (Lachman et al., 2014).

To contextualize the effect sizes found, positive affect had a small effect on changes in memory functioning. This was not unexpected, given that (a) we tracked changes over almost a decade, and (b) many other factors contribute to cognitive aging (Plassman, 2010), such as education, which is a widely studied protective factor in cognitive aging (Stern, 2012) and which had a similarly sized effect on memory changes in the present study.

Directions for future research

An important direction for future research will be to examine pathways linking positive affect and memory, including physical health (e.g., Ong, 2010), neurophysiological changes (e.g., Ashby, Isen, & Turken, 1999), adaptive health behaviors (e.g., Sin et al., 2015), and social relationships (Lyubomirsky et al., 2005). Future research may also focus on positive emotions in other response systems (e.g., behavior, physiology), time scales (e.g., momentary), and assessment methods (e.g., experience-sampling methods). Researchers and policymakers share an interest in how we can prevent or slow down memory decline. The present findings highlight the potential for positive-affect screenings to identify older adults who may be at risk for memory decline. Existing intervention research has focused on reducing risk factors (Geerlings et al., 2000) or promoting protective factors such as physical activity (Ruscheweyh et al., 2011) that may require significant time and motivational investment. Although the present findings do not allow for causal claims, future randomized studies could evaluate the effects of positive-affect interventions (e.g., Moskowitz et al., 2017) on memory decline over shorter time intervals.

Strengths and limitations

The present study has strengths and limitations. As strengths, our study focused on trait positive affect using items from the PANAS, a gold-standard measure (Pressman & Cross, 2018), and showed that findings remained stable when analyses used another measure of positive affect from ABS-GWB, which has been used previously (Mroczek & Kolarz, 1998). Further, we assessed objective memory performance with two widely used recall tests, demonstrated longitudinal associations over almost a decade, and used a large-scale national sample of middle-age and older U.S. adults.

To address limitations of the study, future research should (a) examine positive emotions using laboratory-based and experience-sampling approaches; (b) assess other aspects of memory functioning (e.g., Buckner, 2004), along with false-alarm rates on memory tasks; (c) use multiwave longitudinal designs and appropriate statistical techniques to examine how between- and within-person changes in affect are related to changes in memory; and (d) carefully probe whether the present findings generalize to other contexts (e.g., less positively selected and more heterogeneous segments of the larger population) and countries (cf. Berk et al., 2017; Brailean et al., 2016).

Conclusion

In the year 2050, about 20% of the U.S. population is projected to be over 65 years old. Memory decline is a hallmark of both normal and pathological aging and represents a pressing public health concern for "graying" populations around the globe. The present large-scale longitudinal study shows that more positive affect is associated with less memory decline over 9 years in mid and late life. These findings may be of interest to affective, cognitive, and developmental scientists.

Transparency

Action Editor: Caren Rotello
Editor: D. Stephen Lindsay
Author Contributions
C. M. Haase formed the project idea. E. F. Hittner analyzed the data in collaboration with C. M. Haase. E. F. Hittner, J. E. Stephens, N. A. Turiano, D. Gerstorf, M. E. Lachman, and C. M. Haase interpreted and discussed the results. E. F. Hittner wrote the manuscript, and J. E. Stephens, N. A. Turiano, D. Gerstorf, M. E. Lachman, and C. M. Haase provided critical revisions. All authors approved the final version of the manuscript for submission.
Declaration of Conflicting Interests
The author(s) declared that there were no conflicts of interest with respect to the authorship or the publication of this article.
Funding
This research was supported by Retirement Research Foundation Grant No. 2017-030 to C. M. Haase. E. F. Hittner is funded through the U.S. Department of Education, Institute of Education Sciences, Multidisciplinary Program in Education Sciences (Grant Award No. R305B140042). The Midlife Development in the United States (MIDUS) study was funded through National Institute on Aging Grant Nos. AG PO1 20166 and AG U19-051426.
Open Practices
Data for the present research were taken from the Midlife in the United States (MIDUS) study and are publicly available at http://midus.wisc.edu/data/index.php. The design and analysis plans for the study were not preregistered. This article has received the badge for Open Data. More information about the Open Practices badges can be found at http://www.psychologicalscience.org/publications/badges.

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Acknowledgments

We thank all Midlife in the United States (MIDUS) study participants and the research team.

Supplemental Material

Additional supporting information can be found at http://journals.sagepub.com/doi/suppl/10.1177/0956797620953883

Notes

1. Findings remained stable when we used positive affect (ASB-GWB) only at Time 2.

2. Participants were given 90 s to recall words in the delayed-recall task.
3. Follow-up analyses similarly showed that associations between positive affect (PANAS) and changes in memory (using a change score; Time 3 – Time 2) were not moderated by age ($\beta = 0.00$, $p = .617$), gender ($\beta = -0.10$, $p = .252$), or education ($\beta = 0.01$, $p = .490$), controlling for covariates.
4. Positive affect (PANAS; $\beta = 0.08$, $p = .003$) and positive affect (ABS-GWB; $\beta = 0.06$, $p = .023$) were associated with lower levels of memory decline over 9 years when analyses merely controlled for age ($\beta = 0.08$, $p = .003$).

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