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Does Perceived Generativity Mediate the Association Between Optimism and Cognitive Function Over Time? Findings from Midlife in the United States Study

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Abstract

Cognitive function is a vital component of healthy aging. However, whether a persistently high optimism benefits late-life cognitive function is debatable. The current study examined associations between high optimism status, perceived generativity, and cognitive functions across adulthood. Data were from waves 2 and 3 (2004–14) of the Midlife in the United States study. We used structural equation modeling to examine whether participants' ($N = 2{,}205$; $M_{age} = 65 \pm 11$) persistent high optimism predicts better cognitive functions over time, compared to high optimism at only one time-point or not at all while controlling for covariates; we also examined whether individuals' perceived generativity mediates the above association. The findings revealed that persistent high optimism was significantly associated with better episodic memory and executive function. Further, perceived generativity positively mediated the association between persistent high optimism and episodic memory. Future research should examine mechanisms for potential aspects of high optimism and perceived generativity on late-life cognitive performances.

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MIDUS, optimism, generativity, episodic memory, executive function

Introduction

Cognitive function is an important component of well-being in later life (Chung et al., 2023). Episodic memory and executive function are two cognitive domains that have been extensively studied in late adulthood (Glisky et al., 2022; Lee, 2014). Episodic memory is associated with one's recollection of time and place-specific personal experiences, while executive functions denote cognitive abilities such as planning, reasoning, organizing, and problem-solving (Harada et al., 2013; Lee, 2014). Although both of these cognitive abilities are associated to some extent with age-related decline (Glisky et al., 2022; Harada et al., 2013; Yang et al., 2020), the rate of decline has been found to be associated with individuals' various facets of positive psychological well-being and shows interpersonal and intrapersonal variation (Cheng et al., 2023).

Optimism is a psychological attribute comprising the hope of a favorable future and the expectation of good things to happen and is considered a facet of positive psychological well-being (Ferguson & Goodwin, 2010; Lee et al., 2019). Prior research has found that a high level of optimism is significantly associated with higher socioeconomic status indicators, including higher education and income (Boehm et al., 2015). Earlier research has also found that optimism is correlated with better physical and psychological well-being compared to pessimism (Conversano et al., 2010). For example, optimism is associated with various health outcomes, such as cardiovascular disease (Kubzansky et al., 2001) and respiratory disorders (Kim et al., 2017). High levels of optimism have been associated with a reduced risk of early mortality (Kim et al., 2017) and achievement of exceptional longevity (Lee et al., 2019). Research has also suggested that higher optimism can lead to healthy dietary habits or other psychosocial behaviors (Hingle et al., 2014). Although most research identified optimism as a protective factor for various physical and psychological health outcomes, some studies yielded contradictory findings. For example, Schofield and colleagues found that optimism was not associated with lower mortality rates among lung cancer patients (Schofield et al., 2004). Likewise, a high level of optimism was associated with significantly impairing the immune defense mechanism (Conversano et al., 2010). Although optimism may change across the life span, in general, it is associated with better health outcomes in later life, including physical and cognitive functioning (Colby & Shifren, 2013). Further, individuals' expectations, beliefs, and goals are varied in particular situations, which can actively impact behavioral outcomes, such as cognitive performances in later life (Oh et al., 2022).

In this context, generativity, another facet of positive psychological well-being, identifies some late-life motivational characteristics, such as developing relationships with family, making commitments to other people, and mentoring the next generation (Doerwald et al., 2021; Kruse & Schmitt, 2012). Although the concept of generativity

is focused on interacting with the younger generation, generativity is a commitment to care and concern for others in the entire community (Gruenewald et al., 2016). Earlier research revealed that generativity was associated with several beneficial well-being outcomes, such as job satisfaction, greater productivity, leadership effectiveness, and engagement in meaningful activities particularly in post-retirement age (Doerwald et al., 2021; Gruenewald et al., 2016; Zhan et al., 2015). Regarding health outcomes, positive perceptions of generativity were also found to be associated with better cognitive and physical functioning (Gruenewald et al., 2016). Although generative behavior is not often accepted and maintained by the younger generation (Kruse & Schmitt, 2012), many consider it important for maintaining social interactions and, thereby, beneficial for cognitive outcomes in later life (Grossman & Gruenewald, 2017, 2020).

Researchers have determined that there is a positive relationship between optimism and generativity. For example, parental generativity has been found to encourage higher forgiveness and optimism among the younger members of the family (Pratt et al., 2008). A study also found that most of the research participants, who were homeless but optimistic, showed great generative concern and were willing to assist others (Lewis, 2016). Several studies have been conducted focusing on the association between optimism and cognitive functions; however, research on whether persistent high levels of optimism provide any benefit for cognitive function, particularly with advanced age, is limited. Further, research on whether perceived generativity mediates the association between persistent high optimism status and cognitive functions in participants across adulthood is also not very common. This study views cognitive performances as a composite measure to recognize the impacts of positive psychological attributes on individuals' well-being.

Purpose of the Study

From the perspective of the current study, the stress process model provides an appropriate theoretical framework to incorporate multidimensional social factors, such as age, gender, and education, that affect individuals' cognitive functioning (Judge et al., 2010). Stress process theory allows us to understand the resources and support that could protect individuals from compromised cognitive performances. The current study expands prior work by comparing cognitive functioning, assessed as a composite measure via executive function and episodic memory, among individuals who persistently possessed an optimistic outlook versus those who had a high level of optimism at only one time point or not at all. It also examined the mediational effects of perceived generativity in those associations in a nationally representative sample of middle-aged and older adults in the United States while controlling for well-documented correlates of behavioral attributes, including sociodemographic and health factors. We hypothesized that (a) a persistently high level of optimism would predict better scores on both cognitive tests compared with nonpractitioners and (b) perceived generativity mediates the above associations.

Methods

Study Design

The current study used data from the Midlife in the United States (MIDUS) survey, a large-scale longitudinal study spanning 20 years. Wave 2 (2004–05) of MIDUS included 75% of the original respondents of wave 1, and wave 3 (2013–14) included 77% of eligible wave 2 participants (Hughes et al., 2018). Midlife in the United States included tests for cognitive functions in wave 2 and wave 3. In the current study, we included data from cognitive tests of executive function and episodic memory from 2,205 individuals who participated in waves 2 and 3 (2004–2014) and have no missing observations. Both waves 2 and 3 were conducted through the phone and a mailed Self-Administered Questionnaire. We did not seek IRB approval for this study because our analyses are based on a publicly available dataset through the Inter-University Consortium for Political and Social Research.

Measures and Procedure

Dependent variables. As dependent variables, we used episodic memory and executive function that were assessed at waves 2 and 3 with the Brief Test of Adult Cognition by Telephone (Lachman & Tun, 2008). Episodic memory was measured with two tests (immediate and delayed free recall of 15 words, Rays-O). Executive function was measured by inductive reasoning (measured by number series completion), category verbal fluency (measured by verbal ability and fluency in 60 s), working memory span (measured by backward digit span), processing speed (measured by 30-Second and Counting Task, or 30-SACT), and attention switching and inhibitory control (measured by Stop and Go Switch Task, or SGST, calculating reaction times) (Lachman et al., 2014). Results of factor analyses for cognitive tests in MIDUS are reported by Lachman et al. (2014). The tests were z-scored ($M = 0$; $SD = 1$) according to the means and standard deviations of the wave 2 full sample. Lachman et al. (2010) calculated a composite score for both episodic memory and executive function as the mean of the z-scored measures. The same was calculated for the wave 3 sample. In the current analysis, both executive function and episodic memory were measured at wave 3.

Key independent variable. We used optimism levels in various waves as the key independent variable. The overall optimism score was based on a 6-item scale combining the 3 "optimism" items (sample question: whether "*In uncertain times, I usually expect the best*") and the 3 "pessimism" (sample question: whether "*I rarely count on good things happening to me*") items, using the Life Orientation Test-Revised as described by Scheieret al. (1994). Response options ranged from 1 (*a lot agree*) to 5 (*a lot disagree*); overall optimism was constructed in MIDUS by calculating the sum of the 6 items (score range 6–30). Items from "optimism" were reverse-coded so that higher scores represent higher levels of optimism. The optimism score was

considered missing if participants answered fewer than three scale items. For analyses, we considered score 25 as the cutoff for high optimism, similarly as described by Celestine (2019), and categorized the level of optimism as high (1, i.e., score ≥25) and low (0, i.e., score <25). Next, optimism status was coded using four dichotomous indicators: high optimism neither at wave 2 nor wave 3 (reference), high optimism at wave 2 only, high optimism at wave 3 only, and consistently high optimism at waves 2 and 3.

Mediator variables. We used perceived generativity as the mediator variable. Midlife in the United States used a 6-item scale of "Loyola Generativity Scale Contributions' domain measures" (sample question: whether "*Others would say that you have made unique contributions to society,*" "*You have important skills you can pass along to others,*" "*Many people come to you for advice,*" "*You feel that other people need you*," "*You have had a good influence on the lives of many people*," and "*You like to teach things to people*") to measure generativity (McAdams & de St. Aubin, 1992). Response options ranged from 1 (*a lot*) to 4 (*not at all*); the scale score was constructed by calculating the sum of the items. Items were reverse-coded so that higher scores represent higher levels of generativity. The scale was computed for cases that had valid values for at least three items on the scale.

Covariates. We used sociodemographic factors, health, and functional status (at wave 2) as covariates. Sociodemographic variables included age, gender, race, marital status, education, and employment. Age was measured as a continuous variable in years. Gender (0 = *male*, 1 = *female*) was a binary variable, and Race (1 = *White*, 2 = *Black*, 3 = *other*) was measured in three categories; in contrast, marital status (1 = *married*, 2 = *separated/divorced*, 3 = *widowed*, 4 = *never married*) and educational level (1 = *no/some school*, 2 = *high school graduate/in college*, 3 = *graduated from college*, 4 = *having master's/professional degree*) were measured in four categories. Employment status was measured in five categories (1 = *currently working*, 2 = *self-employed*, 3 = *retired*, 4 = *unemployed*, 5 = *other*). We included other variables related to health, including tobacco and alcohol use (1 = regular tobacco/alcohol user, or 0 = not), and whether the participant had chronic condition/s (1 = *yes*, 0 = *no*), including (but not limited to) high blood pressure, stroke, heart problems, diabetes, cancer, and aches/joint stiffness, in past 12 months.

Statistical Analysis

Statistical analyses were conducted with Stata 17.0 SE (College Station, TX) software. We used structural equation modeling to examine whether participants' persistent high level of optimism predicts cognitive functions over the 10 years in comparison with high optimism levels at only one time point or not at all, while controlling for covariates (sociodemographic factors, health and functional status, and cognitive function at baseline); we also examined whether individuals' perceived generativity mediates the above associations. Mediation analyses evaluate the causal effect on the outcome (Hayes, 2015). Although, ideally, the variables should be measured in different

waves, half-longitudinal mediation may be useful to demonstrate the role of mediators in two-wave studies examining the contemporaneous relations between either the exogenous variable and the mediator or the mediator and the outcome (Cole & Maxwell, 2003; Yang et al., 2022). Therefore, the current analyses applied a half-longitudinal study design to examine the effects of generativity (wave 3) on the association between optimism status (waves 2 and 3) and cognitive executive function (*Model 1*), and episodic memory (*Model 2*) at wave 3. Further, as suggested by Gollob and Reichardt (1991), we controlled generativity (wave 2) when predicting generativity (mediator/immediate outcome at wave 3) and cognitive functions (wave 2) when predicting cognitive functions (outcome at wave 3). Statistical significance was evaluated at $P < .05$ (2-sided). Unstandardized regression coefficients (b) and standard error (SE) are reported. Model fit was assessed by the indicators CFI (equal to or higher than 0.90; Gerbing & Anderson, 1992), RMSEA (less than 0.05; Browne & Cudeck, 1992), and SRMR (less than 0.08, however, close to zero is considered as perfect fit; Hu & Bentler, 1998).

Results

Table 1 shows the descriptive statistics of different variables, including participants' sociodemographic and health status at baseline. A total of 2,205 individuals (who completed both wave 2 and wave 3 of MIDUS) aged 42–92 years ($M_{age} = 65 \pm 11$) in wave 3 were included in the analysis. Women made up 56% of the sample, 50% were employed, and 91% were White. Substantial proportions of participants were alcohol users (59%); 82% of the sample had at least one or more chronic conditions. Table 1 also reported participants' high optimism status and scores of perceived generativity. The findings revealed that 13.9% of participants showed a high level of optimism in wave 2 only, 10.2% in wave 3 only, and 34.9% in waves 2 and 3. The mean score of perceived generativity was 16.9 ± 3.9 at wave 3.

Table 2 shows the results of structural equation models predicting the direct effects on cognitive episodic memory and executive function in mid and later life over 10 years. After controlling for baseline (wave 2) sociodemographic and health factors and cognitive episodic memory and executive function, findings revealed that a persistently high level of optimism was independently associated with a better performance in both episodic memory ($b = .143$; $SE = .041$; $P < .05$) and executive function ($b = .056$; $SE = .024$; $P < .05$) in mid and later life over 10 years, compared with a persistent low level of optimism.

In the mediation analyses to examine whether perceived generativity mediates the above associations, after controlling for covariates and prior level generativity and cognitive functions (where appropriate), for episodic memory, the total effect for persistent high optimism, .159, is the effect we would find if there was no mediator in our analysis; it is significant with a z of 3.99. The direct effect for persistent high optimism is .143, which, while still significant ($z = 3.49$), is smaller than the total effect (see Supplemental Table 1). The indirect effect of persistent high optimism that passes

Table 1. Demographic Characteristics of US Adults in MIDUS Wave 3 ($n = 2,205$).

Variables	Overall *M* (*SD*) or Column %	Value Range
High Optimism Status (%)		
Neither	41.0	
W2 only	13.9	
W3 only	10.2	
Both	34.9	
Age in year M (SD)	64.7 (11.0)	42–92
Female (%)	55.6	
Race/ethnicity (%)		
White	90.7	
Black	2.4	
Other	6.9	
Marital Status (%)		
Married	68.0	
Separated/divorced	13.7	
Widowed	11.4	
Never married	6.9	
Education (%)		
No/some school	4.7	
Graduated from school/in college	41.8	
Graduated from college	34.0	
Master's/professional degree	19.5	
Employment (%)		
Working	49.6	
Self-employed	12.3	
Retired	29.7	
Unemployed	1.6	
Other	6.7	
Tobacco user (%)	8.3	
Alcohol user (%)	59.3	
Chronic conditions (%)	82.2	
Optimism score M (SD)	23.4 (4.5)	6–30
Generativity score M (SD)	16.9 (8.9)	6–24
Executive function M (SD)	−0.1 (0.7)	−5.6–2.0
Episodic memory M (SD)	0.0 (1.0)	−2.9–3.6

Note. *M* = mean; *SD* = standard deviation; W2 = wave 2; W3 = wave 3.

Table 2. Structural Equation Models Examining Associations of Cognitive Functions with Levels of Optimism and Generativity in Mid and Later Life ($N = 2,205$).

	Generativity W3			Executive Function W3			Episodic Memory W3		
	(Direct Effects) Model 1&2 (common)			(Direct Effects) Model 1			(Direct Effects) Model 2		
Variables	*b*	*(SE)*	*P* value	*b*	*(SE)*	*P* value	*b*	*(SE)*	*P* value
Intercept	6.385	0.718	**<.001**	0.252	0.111	**.023**	0.591	0.191	**.002**
Key Independent Variable									
High Optimism *(ref. neither)*									
W2 only	0.148	0.194	.447	0.005	0.030	.866	0.036	0.052	.481
W3 only	1.108	0.217	**<.001**	0.032	0.034	.343	0.085	0.058	.144
Both	1.062	0.153	**<.001**	0.056	0.024	**.019**	0.143	0.041	**<.001**
Mediator									
Generativity W3				0.001	0.003	.584	0.016	0.005	**.001**
Executive Function W2				0.511	0.012	**<.001**			
Episodic Memory W2							0.428	0.019	**<.001**
Generativity W2	0.601	0.017	**<.001**						
Covariates at W2									
Age, *years*	−0.022	0.007	**.003**	−0.012	0.001	**<.001**	−0.023	0.002	**<.001**
Female *(ref. male)*	0.352	0.134	**.009**	−0.019	0.021	.363	0.323	0.037	**<.001**
Race/ethnicity *(ref. other)*									
White	0.074	0.322	.819	0.028	0.050	.579	−0.003	0.086	.972
Black	1.525	0.502	**.002**	−0.187	0.078	**.017**	−0.425	0.134	**.001**
Marital Status *(ref. never married)*									
Married	0.260	0.234	.265	0.061	0.036	.092	−0.007	0.062	.911
Separated/divorced	0.113	0.282	.688	0.014	0.044	.757	−0.092	0.075	.220

(Continued)

Table 2. Continued

	Generativity W3			Executive Function W3			Episodic Memory W3		
	(Direct Effects) Model 1&2 (common)			(Direct Effects) Model 1			(Direct Effects) Model 2		
Variables	*b*	*(SE)*	*P* value	*b*	*(SE)*	*P* value	*b*	*(SE)*	*P* value
Widowed	0.065	0.359	.856	−0.030	0.055	.591	0.100	0.095	.295
Education *(ref. no/some school)*									
Graduated from school	−0.092	0.310	.766	0.006	0.048	.906	0.065	0.083	.434
Graduated from college	−0.080	0.319	.802	0.038	0.051	.454	0.104	0.086	.222
Master's/prof. degree	0.639	0.336	.057	0.074	0.054	.171	0.138	0.090	.124
Employment *(ref. other)*									
Working	0.325	0.232	.161	0.128	0.036	**<.001**	0.087	0.062	.159
Self-employed	0.732	0.282	**.009**	0.034	0.044	.437	0.032	0.075	.673
Retired	−0.127	0.269	.636	−0.031	0.042	.462	0.025	0.072	.727
Unemployed	0.086	0.477	.856	0.042	0.074	.571	−0.055	0.127	.667
Tobacco user	−0.460	0.191	**.016**	−0.035	0.030	.242	−0.067	0.051	.188
Alcohol user	−0.059	0.132	.656	−0.008	0.020	.699	0.016	0.035	.656
Chronic conditions	0.173	0.151	.253	−0.019	0.023	.427	0.002	0.040	.953

Note. W2 = wave 2; W3 = wave 3.
Bold numbers highlight the significant *P* values.

through perceived generativity is .017 and statistically significant. The findings revealed that the proportion of the total effect that is mediated is almost .11; the ratio of the indirect effect to the direct effect is about .12, and finally, the total effect is about 1.1 times the direct effect. We, therefore, conclude that generativity mediates the relationship between optimism and episodic memory. On the other hand, for executive function, the total effect for persistent high optimism is .057; it is the effect we would find if there was no mediator in our model. It is significant with a z of 2.47. The direct effect for persistent high optimism is .056, which, while still significant (z = 2.34), is smaller than the total effect (see Supplemental Table 1). The indirect effect of persistent high optimism that passes through perceived generativity is .002, but statistically not significant. The findings revealed that the proportion of the total effect that is mediated is almost .04. The ratio of the indirect effect to the direct

effect is about .04; finally, the total effect is about 1.0 times the direct effect. Therefore, we conclude that generativity does not mediate the relationship between optimism and executive function.

Figure 1 illustrates the schematic diagrams of structural equation models examining mediation effects of perceived generativity in the associations between optimism and executive function (*Model 1*) and optimism and episodic memory (*Model 2*), controlling for covariates and prior level generativity and cognitive functions (where appropriate; effects of covariates not shown in the diagram) in each equation. In the current study, the model fit was good for both *Model 1* (CFI = 0.998, RMSEA = 0.040, and SRMR = 0.002) and *Model 2* (CFI = 1.00, RMSEA = 0.015, and SRMR = 0.002).

Discussion

The current study provides a contribution to the existing literature with population-based, longitudinal evidence that positive psychological attributes, such as persistent high level of optimistic outlook and perceived generativity, positively affect late-life cognitive functioning in the US middle-aged and older adult population over 10 years. Guided by the stress process model, the multidimensional perspective of individuals' optimistic outlook and perceived generativity addresses various aspects of cognitive functioning. Supporting our first hypothesis, the findings revealed that persistently high levels of optimism in both waves 2 and 3 significantly positively affected cognitive executive functions and episodic memory compared to participants who elicited high optimism levels at only one time point or none. In partial support for our second hypothesis, the findings revealed that perceived generativity significantly and positively mediates the association between persistent high optimism and episodic memory; however, it had no significant effect on the association between persistent high optimism and executive functions over 10 years in mid and later life.

In this context, high levels of optimism have been found to be associated with increased physical activity (Pavey et al., 2015), reduced stress (Jobin et al., 2014), and increased well-being (Conversano et al., 2010). Negative effects of stress on cognitive function are well-documented (Marin et al., 2011; Scott et al., 2015). During stress, an individual's sympathetic nervous system is triggered; as a result, various inflammatory neurotransmitters are released, which may have adverse effects on (cognitive) health (Bhattacharyya et al., 2021). It is documented that optimistic individuals show more frequent protective attitudes; they are more resilient to stress, perhaps through various coping strategies (Anzaldi & Shifren, 2019; Conversano et al., 2010). Individuals with higher optimistic outlook may show stress-reducing effects through engagement in physical activities and maintaining better social interactions (Smith et al., 2013); these factors might be linked with higher levels of cognitive function found in previous studies. Further, earlier research suggests that while excessive stress can be detrimental to cognitive functioning, milder stress may enhance cognitive performance, especially immediate memory functions (Jütten et al., 2020; O'Sullivan

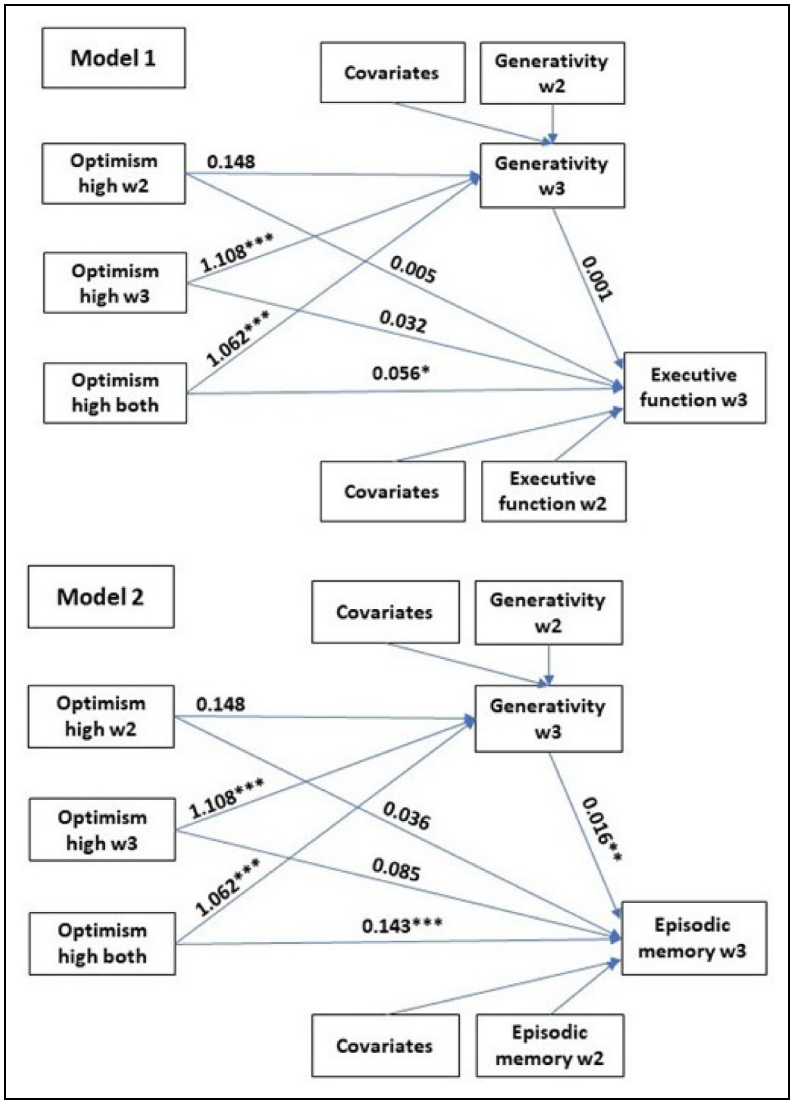

Figure 1. Structural equation model showing mediating roles of generativity in the association between levels of optimism in different waves and cognitive episodic memory and executive function in mid and later life over 10 years ($n = 2,205$), controlling for covariates ($n = 2,205$; model 1 goodness of fit criteria: CFI = 0.998, RMSEA = 0.040, and SRMR = 0.002; model 2 goodness of fit criteria: CFI = 1.00, RMSEA = 0.015, and SRMR = 0.002). *Note*. w2 = wave 2; w3 = wave 3. ***$P < .001$; **$P < .01$; *$P < .05$. Covariates were included in all SEM equations; also, we controlled for prior wave executive memory, episodic function, and generativity where appropriate; however, effects of covariates/control variables were not shown in the diagram.

et al., 2019). A recent study suggests that beneficial consequences of optimism may be associated with individuals' cortisol secretion; the researchers found that pessimists secreted relatively elevated diurnal cortisol on days with higher perceived stress levels; in contrast, optimists were protected from these stress-related elevated cortisol levels (Jobin et al., 2014). Cortisol is a hormone that is secreted by the hypothalamus–pituitary–adrenal (HPA) axis in response to stress and follows a diurnal rhythm pattern (Endrighi et al., 2011; Jobin et al., 2014). Optimism is likely to have a down regulatory effect on the sympathetic nervous system and HPA axis in response to stress (Endrighi et al., 2011); this may explain why a persistently high level of optimism heightens some domains of cognitive performance.

Our findings corroborate the existing literature showing mixed effects concerning why perceived generativity status yielded differences in episodic versus executive cognitive performances. Perhaps our finding regarding more consistent scores on executive functioning versus episodic tasks suggests that executive functioning is more hard-wired into the aging process; in contrast, episodic memory is more amenable to "behavioral influences." In this context, it should also be considered that more generative individuals often engage themselves in more meaningful activities, such as mentoring grandparents, on the basis of their better physical and cognitive health and their sense that they can do the job (Roth et al., 2009). This self-selection bias could be a potential confound because it may make them perform better than less generative individuals in some specific cognitive dimensions (Roth et al., 2015).

Limitations

The main strength of the current study is its national representative sample and large sample size; however, it has several limitations. For example, its half-longitudinal nature may induce some generalizability bias; theoretically, we can test whether generativity is a partial mediator, but we cannot test whether generativity completely mediates the association between optimism and cognitive function. Also, our analyses were based on two data points on cognitive function, which precluded the analysis of nonlinear trends (e.g., accelerated cognitive decline). Another limitation is related to recall bias because responses were collected retrospectively. Further, the interval between the studied waves was 10 years. Finally, as MIDUS did not screen the participants for cognitive impairment at baseline, we were unable to comment on the neurocognitive status of the participants in our sample.

Conclusion

Overall, our findings that a persistently high optimism predicts positive change in cognitive functions in mid and later life over 10 years corroborates earlier research findings. While cognitive decline is often examined in relation to other risk/protective factors in late adulthood, this study further identified that persistent high optimism has associations with cognitive outcomes in middle-aged and older adults. Future

research should examine mechanisms for elevating high optimism and perceived generativity on cognitive performances across adulthood.

Declaration of Conflicting Interests

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Supplemental Material

Supplemental material for this article is available online.

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