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Variety of Enriching Early-Life Activities Linked to Late-Life Cognitive Functioning in Urban Community-Dwelling African Americans

Thomas Chan, PhD,[1,2] Jeanine M. Parisi, PhD,[1] Kyle D. Moored, BS,[1,2] and Michelle C. Carlson, PhD[1,2]

[1]Department of Mental Health and [2]Center on Aging and Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland.

Address correspondence to: Thomas Chan, PhD, Center on Aging and Health, Johns Hopkins Bloomberg School of Public Health, 2024 E. Monument Street, Suite 2-700, Baltimore, MD 21231. E-mail: thomas.chan@jhu.edu

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Abstract

Objectives: The early environment is thought to be a critical period in understanding the cognitive health disparities African Americans face today. Much is known about the positive role enriching environments have in mid- and late-life and the negative function adverse experiences have in childhood; however, little is known about the relationship between enriching childhood experiences and late-life cognition. The current study examines the link between a variety of enriching early-life activities and late-life cognitive functioning in a sample of sociodemographic at-risk older adults.
Method: This study used data from African Americans from the Brain and Health Substudy of the Baltimore Experience Corps Trial ($M = 67.2$, $SD = 5.9$; $N = 93$). Participants completed a battery of neuropsychological assessments and a seven-item retrospective inventory of enriching activities before age 13.
Results: Findings revealed that a greater enriching early-life activity score was linked to favorable outcomes in educational attainment, processing speed, and executive functioning.
Discussion: Results provide promising evidence that enriching early environments are associated with late-life educational and cognitive outcomes. Findings support the cognitive reserve and engagement frameworks, and have implications to extend life-span prevention approaches when tackling age-related cognitive declines, diseases, and health disparities.

Keywords: Cognitive reserve, Developmental assets, Health disparities, Life course, Minority research

Participation in cognitively enriching activities earlier in the life span is hypothesized to protect against age-related cognitive declines and diseases (Carlson, 2011; Carlson, Eldreth, Chuang, & Eaton, 2012; Chan & Carlson, 2016; Gow, Pattie, & Deary, 2017; Stern, 2002; Wu, Rebok, & Lin, 2016). Enriching social and affective activities such as volunteering, multilingualism, and musical activities have been associated with late-life cognitive functioning (Carlson et al., 2012b; Craik, Bialystok, & Freedman, 2010; Hanna-Pladdy & MacKay, 2011; Kensinger & Gutchess, 2016). Much of this evidence relates to mid- to late-life, such that adults who engaged in more cognitively enriching activities show greater resiliency to both normal and pathological forms of age-related cognitive decline (Carlson et al., 2009, 2012b; Ghisletta, Bickel, & Lövdén, 2006; Stine-Morrow, Parisi, Morrow, & Park, 2008; Wilson et al., 2005). Very little, however, is known about the link between cognitively enriching activities in childhood (before age 13) and late-life cognitive functioning. The current study builds upon what is known about mid- to late-life enrichment to examine the association between cognitively enriching activities in childhood and late-life cognition.

Investigating the role of early-life enrichment on late-life health may be a key to better understanding cognitive health disparities faced by sociodemographic at-risk groups. There is little or weak evidence to support genotypic differences between races or ethnicities; however, African Americans as a whole are still far more at-risk to suffer from late-life cognitive impairments and diseases compared with predominately Caucasian samples (Mayeda, Glymour, Quesenberry, & Whitmer, 2016; Tang et al., 2001). Much empirical evidence points to examining risk and protective factors—especially early in life—to identify and address reasons why some individuals are afflicted by cognitive impairments and disorders while others, even from the same upbringing, are resilient to developing them (Masten, 2001; Moceri et al., 2001; Sisco et al., 2015; Stern, 2002).

Together, for older African Americans, little is known about whether cognitive enrichment in early life fosters resiliency against age-related cognitive declines and impairments. This study investigates whether this connection exists in a sociodemographically heterogeneous sample of aging African Americans with the goal of building reserve and resilience for those who are most at-risk for dementia.

Variety of Enriching Early-Life Activities Builds Cognitive Reserve

Multiple works have suggested that engaging in a *variety* of enriching activities supports positive cognitive functioning (Carlson et al., 2012b; Parisi et al., 2012). The link between earlier life enrichment and late-life cognition stems from Stern's (2002) seminal concept of cognitive reserve. The cognitive reserve hypothesis suggests that engaging in enriching activities earlier in the life span builds neuroprotective assets (i.e., reserves) that help delay the onset of clinical deficits (e.g., age-related cognitive declines, Alzheimer's disease) until this reserve is overwhelmed by the expression of pathology. In support, Bradley et al. (1989) found in three ethnic groups that the number of play materials in the home, and the variety of experiences to which children are exposed, were positively related to their subsequent cognitive development. Additionally, Wilson and colleagues (2005) found that the frequency of early-life activities (retrospectively recalled from age 6 to 12), both inside and outside the home (e.g., reading newspapers, going to a museum), were associated with semantic memory and perceptual speed in a sample of older adults from 25 residential facilities. Despite few studies, almost nothing is known about whether engaging in a variety of enriching activities outside the home in childhood is related to late-life cognition.

The empirical evidence that demonstrates that a variety of enriching activities outside the home in early life are neuroprotective comes from studies that have consistently found links between educational attainment and late-life cognition (e.g., Kemppainen et al., 2008; Richards & Sacker, 2003; Stern, Albert, Tang, & Tsai, 1999). These findings generally support what the cognitive reserve and engagement hypotheses predict—educational opportunities promote a venue to experience a greater variety of cognitively stimulating activities that help build cognitive reserve (Stern, 2002).

Although evidence points to engagement in enriching activities outside the home in early life to be beneficial to late-life cognition, historically sociodemographic at-risk populations are less likely to experience adequate enrichment; they may even experience deprivation, as contextual opportunities to engage in cognitively stimulating activities may be resource restricted both inside and outside the home. Specifically, African Americans who grow up in the inner city—such as Baltimore—are at a higher risk for developing cognitive impairments throughout the life span because socioeconomic barriers may limit these cognitively protective opportunities (the Baltimore Memory Study; Schwartz et al., 2003).

Congruently, much work shows that impoverished early-life conditions—inside and outside the home—correspond with poorer cognitive outcomes (Duncan, Brooks-Gunn, & Klebanov, 1994) and increased risk of developing dementia or Alzheimer's disease (Borenstein, Copenhaver, & Mortimer, 2006; Melrose et al., 2014). Likewise, deprivations in early life may also lead to toxic stress responses, which are detrimental to subsequent cognitive development (C. A. McEwen & B. S. McEwen, 2017)—and a potential biological source of health disparities experienced later in life (Shonkoff, Boyce, & McEwen, 2009). For this at-risk group, much has been highlighted with deprivation and poorer later life cognition; however, much less is known about early-life enrichment as building cognitive reserves in childhood: an encouraging avenue to ward off potential downstream cognitive impairments and pathologies (Richards & Sacker, 2003; Stern, 2002).

Taken together, urban-dwelling African Americans are most at-risk of developing late-life cognitive impairments and diseases (Mayeda et al., 2016; Tang et al., 2001). This may be due, in part, to early-life factors, potentially during the formative childhood years when cognitive development sets the foundation for subsequent maturation. The cognitive reserve and engagement hypothesis suggest that enriching activities in early life are important to late-life cognition (Carlson, 2011; Carlson, Eldreth, Chuang, & Eaton, 2012a; Schooler, Mulatu, & Oates, 1999; Stern, 2002; Stine-Morrow et al., 2008, 2014). Thus, a vital question to study is whether engagement in enriching activities in early life is associated with late-life cognitive performance for those most at-risk to developing cognitive impairments and disorders (illustrated visually in Figure 1). This study examines the link among early-life engagement in enriching activities, educational attainment, and late-life cognition in a sample of sociodemographically at-risk urban community-dwelling African Americans.

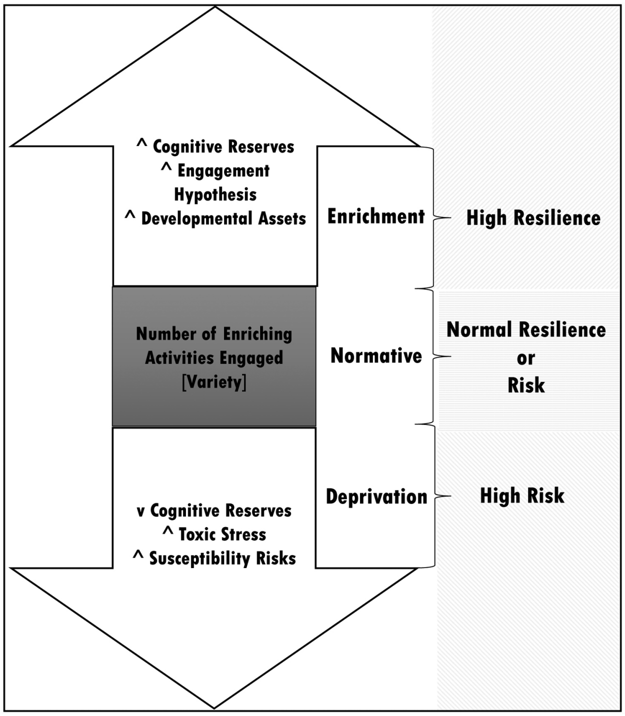

Figure 1. The diagram illustrates the hypothesized connections between cognitive enrichment in early life and the development of resiliency against age-related cognitive declines and impairments. People who engage in more cognitively enriching activities earlier in life build their cognitive reserves (i.e., neuroprotective assets) exponentially against age-related cognitive declines and impairments. Contrastly, people deprived of enriching activities in early life experience an increased risk of observing evidence of age-related cognitive declines and impairments. It should be noted that cognitive resiliency is plastic throughout the life span and contributions could always be made to cognitive reserves; however, just like compound interest, the growth is not as multiplying as if contributions were made earlier in life.

METHOD

Participants

The Baltimore Experience Corps Trial (BECT) was a randomized, controlled trial designed to examine the health benefits to older adults who participated in a community-based intervention. Specifically, participants who were randomized into the intervention condition were trained to assist and mentor at-risk youth in Baltimore City elementary schools and those in the control condition were offered to serve in a low-activity volunteering program: see Carlson et al. (2015) and Fried et al. (2013) for a comprehensive description of the sample and procedures. Eligibilities include: (a) 60 or older, (b) speak English, (c) clearance on criminal background check, (d) scored ≥24 on the Mini-Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975), (e) achievement of sixth grade reading level on Wide Range Achievement Test (WRAT; Wilkinson & Robertson, 2006), and (f) agreeing to serve 15 or more hours per week for two school years if randomized into the intervention condition.

From within the BECT sample, 123 of these people were enrolled in the Brain and Health Substudy (BHS) to participate in more in-depth assessments (e.g., functional magnetic resonance imaging [fMRIs], biomarkers, life history questionnaires). Importantly, BHS participants did not differ from the larger BECT sample in age, gender, education, MMSE scores, or self-reported health (Carlson et al., 2015). *Prior to randomization* to the intervention or control condition, all participants underwent an extensive battery of assessments to record their respective baseline metrics. Baseline assessments included neuropsychological and cognitive functioning, health history, physical ability, and current and past living conditions and activities (for more details, see Carlson et al., 2015).

The current study sample is restricted to African American BHS participants (N = 93) who completed the enriching early-life activities (EELAs) inventory. This study was approved by the Johns Hopkins School of Medicine IRB and each participant provided written, informed consent.

Measures

Enriching early-life activities

EELAs assessed whether participants engaged in cognitively enriching activities in childhood. The inventory asked participants to answer "yes" or "no" to whether they engaged in each of the following seven activities before age 13: (a) learning a foreign language, (b) volunteering at church, (c) taking lessons (i.e., dance, choir), (d) playing a musical instrument, (e) scouting, (f) playing team sports, and (g) taking vacations. Endorsement of each activity was tallied to derive a total score ranging from 0 to 7, with a higher score indicating greater engagement in a variety of cognitively enriching activities in early life (no = 0, yes = 1).

Educational attainment

Educational attainment was computed based on the number of total years of formal education completed. These years were placed into categories of high school or less, college, and post-college.

Cognitive assessment

The current study used a standardized battery of neuropsychological tests to evaluate the cognitive abilities of older adults. Assessments were conducted by trained technicians who followed standardized protocols.

Processing speed

Pattern Comparison Task

Pattern Comparison Task (PCT) is a paper-and-pencil test assessing visual processing speed (Salthouse & Babcock, 1991). Participants were asked to determine whether two patterns were either the same or different as quickly as possible. Scores were the number of correct patterns distinguished in 30 s.

Trail Making Task – Part A

Trail Making Task – Part A (TMT-A) is a paper-and-pencil test assessing psychomotor and visual search speed

(Reitan, 1958). Participants were asked to sequentially connect numbers on a page as quickly as possible (maximum 240s). Scores were the time it took to complete the task.

Memory

The Wechsler Digit Span Backward

Digit Span Backward (DSB) task is a verbal test assessing auditory working memory. Participants were asked to recall in backward sequential order a list of numbers that were read aloud to them. Scores were the longest chain of correctly recalled numbers.

The Rey Auditory Verbal Learning Test – Immediate Recall and Rey Auditory Verbal Learning Test – Delayed Recall

Rey Auditory Verbal Learning Test – Immediate Recall (RAVLT-IR) and RAVLT – Delayed Recall (RAVLT-DR) are verbal tests assessing auditory verbal learning (Rey, 1964; Schmidt, 2004). Participants were asked to recall a 15-word list over five sequential learning trials. Scores on the RAVLT-IR were the sum of correctly recalled words over the five trials. Scores on the RAVLT-DR were the number of correctly recalled from the list following a 20-min delay.

Executive functioning

Trail Making Task – Part B

TMT-B is a paper-and-pencil test administered after the TMT-A assessing planning and attentional flexibility: hallmarks of executive set-shifting (TMT-B; Reitan, 1958). Participants were asked to connect *numbers and letters* in an ascending alpha-numeric sequence as quickly as possible (maximum 420s). Scores were the time it took to complete the task and TMT-A completion times were used as covariates in models as baseline controls for individual psychomotor speed.

The Stroop Color-Words

Stroop Color-Words (Stroop C-W) is a computerized test assessing inhibitory control (Trenerry, Crosson, DeBoe, & Leber, 1989). Participants were presented with names of colors (e.g., red, green, blue) and asked to identify the color ink of these words. Congruent trials were those where the color ink and the word matched, whereas incongruent trials were those where the color ink and word were different (e.g., "green" written in blue ink). Inhibitory scores (i.e., the Stroop effect) were reaction times on correct trials. The Stroop Color (Stroop-C) portion, with no interfering words (e.g., "green" written in green ink), was used as a baseline covariate to control for individual reaction times.

Covariates

Age, gender, mother's socioeconomic status, and variety of late-life activities on the Lifestyle Activities Questionnaire (LAQ) were used as covariates in the main analyses. The subjective socioeconomic status of participants' mothers was incorporated into models to capture the relative socioeconomic experiences in early life. This was measured with a subjective social economic ladder ranging from 1 to 10 (worst off to best off), where participants were asked to consider their mother's socioeconomic standing (see Adler, Epel, Castellazzo, & Ickovics, 2000).

The variety of LAQ was used to control for current activity levels that have been found to be associated with cognitive functioning (Carlson et al., 2012b) ranging from doing volunteer work, gardening, and cooking. Binary scores (0 = never or less than once a month, 1 = at least once a month) were created and summed to yield a variety of late-life activity scores (see Carlson et al., 2012b).

Analysis Plan

Multiple linear regression modeling was used to examine the unique contribution of EELAs in predicting educational attainment and late-life cognitive functioning on tasks of processing speed, memory, and executive functioning, after adjusting for covariates. After testing the hypothesized link between EELAs and educational attainment, educational attainment was incorporated in final models as covariates to isolate the unique variance EELAs may explain. Prior to conducting linear regression models, descriptive statistics and plots, Shapiro–Wilk's tests, and missing value analysis were used to screen and examine characteristics of the sample. Skewed variables such as Stroop, TMT-A, and TMT-B assessments were log-transformed to meet normality assumptions for parametric analyses. Multiple imputation procedures were used to handle missing data—a less biased method to handle missing data compared with traditional listwise or pairwise deletion techniques (Schafer & Olsen, 1998). All available data (predictors, covariates, cognitive assessments) were used in a fully conditional specification procedure (MCMC; 10 maximum iterations) to generate 10 imputed data sets.

Results

Characteristics of the Sample

Table 1 presents this study sample's demographic characteristics, cognitive functioning, and degree of engagement in early- and late-life activities. Participants (N = 93) were an average age of 67.2 years (SD = 5.9), were majority females (71%), and rated their mother's socioeconomic status to be relatively standard (M = 5.6, SD = 2.4, range 1–10). The sample completed an average of 14.1 years of education (SD = 2.6). Baseline global cognition was intact: MMSE (M = 28.3, SD = 1.5). The sample had a minimal prevalence of depressive symptoms: 1 out of 93 participants scored >10 on the Geriatric Depression Scale (M = 1.3, SD = 1.9).

Results from Little's Missing Completely at Random (MCAR) test did not suggest systematic missingness in the data χ^2 (69, N = 93) = 69.11, p = .47. Results from separate variance t-tests revealed that missing data on the late-life activities covariate were were not completely missing at random as those with lower educational attainment

Table 1. Demographic and Cognitive Characteristics of Participants

	M	*SD*	Range
Age (71% female, 29% male)	67.2	5.9	60.0–82.3
Years education completed	14.1	2.6	8.0–21.0
Mother's socioeconomic status	5.6	2.4	1.0–10.0
Late-life cognition			
Mini-Mental State Examination	28.3	1.5	24.0–30.0
WRAT	58.6	6.6	44.0–70.0
Speed of processing			
Trial Making Task – Part A	1.6	0.1	1.4–1.9
Pattern Comparison Task	26.6	5.0	16.0–40.0
Memory functioning			
RAVLT – Immediate Recall	39.4	7.3	17.0–55.0
RAVLT – Delayed Recall	6.6	2.6	0–12.0
Digit Span Backwards	5.1	2.3	0–11.0
Executive functioning			
Trial Making Task – Part B	2.0	0.2	1.7–2.6
Stroop Color-Word	3.1	0.1	2.9–3.3
Variety of activities			
Late life (# endorsed of 29)	18.5	3.4	11.0–25.0
Early life (# endorsed of 7)	3.1	1.7	0–7.0
Learning a foreign language (% endorsed) 15.1%			
Playing a musical instrument			31.2%
Scouting			37.6%
Taking lessons			46.2%
Playing team sports			51.6%
Volunteering at church			54.8%
Taking vacations			68.8%

Note: RAVLT = Rey Auditory Verbal Learning Test; WRAT = Wide Range Achievement Test. Log-transformed: Trial Making Task – Part A and Part B, Stroop Color-Word. *N* = 93.

had higher levels of missingness values, $t(14.7) = -3.40$, $p < .01$. Otherwise, missing was relatively minimal on covariates and outcomes: mother's socioeconomic status (6.45%) and variety of late-life activities (10.75%); cognitive assessments—Stroop-C (5.38%), Stroop C-W (6.45%), TMT-B (1.08%), and DSB (1.08%). Lastly, participants reported being involved in an average of 18.3 activities in later life (*SD* = 3.2). In terms of the current study's main variable of interest, EELAs, participants reported engaging on average in three of seven activities in early life (childhood; *SD* = 1.7).

EELAs and Educational Attainment

Table 2 displays the results from linear regression modeling (final step). These results revealed that the degree of engagement in EELAs uniquely predicted educational attainment ($\beta = .29$, $p < .05$).

EELAs and Processing Speed

Table 3 displays results showing that the degree of engagement in EELAs uniquely predicted PCT ($\beta = .38$, $p < .001$) and trended in significance in predicting TMT-A ($\beta = -.22$, $p = .054$).

Table 2. Variety of EELAs Predicting Educational Attainment

	Educational attainment		
Final model	*B*	*SE*	β
(Constant)	0.26	1.01	
Age	0.01	0.01	.10
Gender	−0.22	0.18	−.12
Mother's socioeconomic status	−0.06	0.04	−.16
Variety of EELAs	0.14	0.05	.29*
F		2.79*	
R^2		.11	
ΔR^2 EELAs		.07***	

Note: EELAs = enriching early-life activities. *N* = 93.
*$p < .05$. ***$p < .001$.

EELAs and Memory

Table 4 displays the association between engagement in EELAs and memory performance. Results revealed a lack of association between EELAs and RAVLT-IR ($\beta = .19$, $p = .12$), RAVLT-DR either ($\beta = -.06$, $p = .63$), or DSB ($\beta = .18$, $p = .14$).

EELAs and Executive Functioning

Table 5 displays results that the degree of engagement in EELAs uniquely predicted the set-shifting component of executive function, measured by TMT-B ($\beta = -.22$, $p < .05$). In contrast, EELAs did not predict the inhibitory component of executive function, measured by Stroop C-W ($\beta = -.05$, $p = .56$).

Sensitivity Analyses

Sensitivity analyses were conducted to determine if there were specific drivers of the associations observed between EELAs and late-life cognition (presented in Supplementary Table 1, Models 1–4). First, we examined whether one of the seven EELA items was primarily responsible for the associations observed and found that no one activity was a stronger predictor than the summary measure (data not presented; *p*s > .10). Second, we accounted for WRAT scores as a measure of educational quality in our models and found that findings remained consistent with the exception that TMT-A was no longer a significant trend (Model 2, $\beta = .18$, $p = .11$). Third, we excluded specific covariates that could serve as potential mediators of cognitive reserve, including late-life LAQ (Model 3) and educational attainment (Model 4). Although findings were generally consistent, we found that the RAVLT-IR (Model 3, $\beta = .21$, $p < .10$; Model 4, $\beta = .25$, $p < .05$) and DSB (Model 3, $\beta = .20$, $p < .10$;

Table 3. Variety of EELAs Predicting Processing Speed

	Trail Making Task – Part A			Pattern Comparisons Task		
Final model	*B*	*SE*	β	*B*	*SE*	β
(Constant)	1.21***	0.18		39.70***	6.19	
Age	−0.01	0.00	.27**	−0.26	0.08	−.31***
Gender	−0.03	0.03	−.09	1.36	1.07	.12
Mother's socioeconomic status	0.01	0.01	.16	−0.31	0.23	−.14
Educational attainment	0.01	0.02	.06	−0.83	0.63	−.13
Variety of late life activities	0.00	0.00	.04	0.06	0.16	.04
Variety of EELAs	−0.02	0.01	−.22†	1.14	0.33	.38***
F		2.31*			4.85***	
R^2		.14			.25	
ΔR^2 EELAs		.04†			.11***	

Notes: EELAs = enriching early-life activities. Trail Making Task – Part A was log-transformed. *N* = 93.
†*p* = .054. **p* < .05. ***p* < .01. ****p* < .001.

Table 4. Variety of EELAs Predicting Memory Performance

	RAVLT – Immediate Recall			RAVLT – Delayed Recall			Digit Span Backward		
Final model	*B*	*SE*	β	*B*	*SE*	β	*B*	*SE*	β
(Constant)	33.45***	9.66		10.05**	3.50		6.24*	3.11	
Age	−0.08	0.13	−.07	−0.06	0.05	−.01	−0.03	0.04	−.07
Gender	3.71	1.67	.23*	0.73	0.61	.13	0.31	0.55	.06
Mother's socioeconomic status	−0.55	0.35	−.17	−0.13	0.13	−.11	−0.15	0.11	−.16
Educational attainment	0.84	0.99	.09	0.60	0.36	.19	0.30	0.32	.11
Variety of late-life activities	0.27	0.25	.12	−0.03	0.09	−.04	0.00	0.08	.00
Variety of EELAs	0.81	0.50	.19	−0.09	0.18	−.06	0.24	0.16	.18
F		2.18			1.11			0.98	
R^2		.13			.07			.07	
ΔR^2 EELAs		.03			.00			.02	

Note: EELAs = enriching early-life activities; RAVLT = Rey Auditory Verbal Learning Test. *N* = 93.
**p* < .05. ***p* < .01. ****p* < .001.

Table 5. Variety of EELAs Predicting Executive Functioning

	Trail Making Task – Part B[a]			Stroop C-W		
Final model	*B*	*SE*	β	*B*	*SE*	β
(Constant)	0.46	0.29		−0.11	0.30	
Age	0.01	0.00	.25**	0.00	0.00	.10
Gender	−0.07	0.04	−.15	0.03	0.01	.16**
Mother's socioeconomic status	0.03	0.01	.26**	0.00	0.00	−.04
Educational attainment	−0.04	0.02	−.15	0.01	0.01	.06
TMT-A[a] or Stroop-C[b]	0.59	0.14	.38***	1.01	0.09	.80***
Variety of late-life activities	0.00	0.01	.06	0.00	0.01	−.01
Variety of EELAs	−0.03	0.01	−.22*	0.00	0.00	−.05
F		9.02***			28.62***	
R^2		.43			.70	
ΔR^2 EELAs		.03*			.00	

Note: EELAs = enriching early-life activities; Stroop-C = Stroop Color; Stroop C-W = Stroop Color-Word; TMT-A = Trail Making Task – Part A. Trail Making Task – Part B and Stroop C-W were log-transformed. *N* = 93.
**p* < .05. ***p* < .01. ****p* < .001.

Model 4, β = .21, p < .10) now demonstrate a trend or become significant.

Discussion

African American older adults are disproportionately more likely to be afflicted by age-related cognitive declines and diseases (Mayeda et al., 2016; Tang et al., 2001). Much is known about the role adverse early-life experiences have on cognition for at-risk groups; however, we know little about the role of enrichment—a hypothesized link to neuroprotection against age-related declines and diseases (i.e., cognitive reserve; Stern, 2002). Subsequently, the current study analyzed a standardized battery of neuropsychological tests and a seven-item retrospective inventory of EELAs administered to a sample of community-dwelling African American older adults in Baltimore. Results provide evidence that a variety of EELAs were favorably linked to outcomes in later life educational attainment, speed of processing, and executive set-shifting.

These findings extend upon previous work that found protective associations between late-life variety of lifestyle activities and cognition (Carlson et al., 2012b; Parisi et al., 2012) and contributes to the growing body of work on factors of cognitive resilience and reserve throughout the life span (e.g., Richards & Sacker, 2003; Stern, 2002). Additionally, this study used a simple measure, designed to be robust to recall bias, to connect early-life activities to late-life cognition. Growing evidence suggests that using a life span approach is vital to understanding how earlier exposures may be protective to downstream cognitive functioning (e.g., Gow et al., 2017; Wu et al., 2016)—especially important for groups who are at higher risks of developing age-related cognitive impairments and diseases.

Findings also yield support for the benefits of early engagement in a variety of activities to late-life cognition; specifically reinforcing past empirical and theoretical links between engagement and cognitive processing speed (Schooler et al., 1999; Stine-Morrow et al., 2008, 2014) and executive functioning (Carlson et al., 2012a). Speed of processing and executive set-shifting are two cognitive functions that distinctively decline with age—synonymous with being mentally sharp. Early exposure to a variety of enriching activities may prime the cognitive and motivational systems (e.g., need for cognition) of a person to seek novelty and complexity throughout the life course: as almost everything in childhood is novel and requires consistently honing the abilities to differentiate, process, and integrate (Wu et al., 2016). These early abilities related to efficient integration and differentiation are necessary for the "preservation of an alert and vital mind"—one optimal developmental outcome of a person in later life (Csikszentmihalyi & Rathunde, 1998).

In parallel to cognitive reserve, we propose that a variety of enriching experiences facilitates positive emotional development (e.g., cognitive-emotional complexity: Barrett, 2009; subjective well-being: Sheldon, Boehm, & Lyubomirsky, 2012). As suggested by this research, although not exclusively related to enriching activities, we postulate that a variety of experiences may build emotional complexity and ego-resilience—psychological reserves to adapt to later adverse life circumstances (Csikszentmihalyi & Rathunde, 1998). Building these psychological reserves earlier in the life course may represent a core component to developing and strengthening well-being (Masten, Cutuli, Herbers, & Reed, 2009). For instance, a variety of early enriching life experiences may strengthen protective psychological processes linked to defenses against age-related cognitive declines (growth mindsets and open-minded input-driven learning; Chan & Carlson, 2016; Wu et al., 2016) and risk of dementia (purpose in life; Sutin, Stephan, & Terraccino, 2018). Likewise, strengthening psychological reserves earlier in the life course may promote brain reserves in areas most vulnerable to age-related impairments such as the hippocampus and amygdala (Davidson & McEwen, 2012). Overall, further examination of the role that a variety of experiences may have in building reserves is a promising step toward understanding the early-life activities associated with the development of cumulative protection against age-related cognitive declines, diseases, and psychopathologies.

In terms of approach, universally supported theoretical and empirical frameworks—cognitive reserve hypothesis (Stern, 2002) and engagement hypothesis (Carlson, 2011; Carlson et al., 2012b; Schooler et al., 1999; Stine-Morrow et al., 2008, 2014)—warrant the greater need to investigate the link between early-life enrichment and later life cognitive functioning. Although the study of adverse childhood environmental exposures has dominated the literature and has been extremely important to identifying at-risk populations, understanding how enrichment can potentially be protective for cognitive and brain health is correspondingly valuable. The goal of providing early-life enrichment should not only be to guard people against age-related pathology, but also to promote growth to facilitate their long-term potential. Likewise, the absence of the negative (e.g., pathology) does not mean someone is flourishing (Seligman & Csikszentmihalyi, 2000). Investigating the enriching factors of early life are as equally, if not more, important to understand why some people make it and others do not despite coming from similar sociodemographic risk environments.

As a focus on the potential benefits of early-life enrichment, the current study summed the number of enriching childhood experiences via the variety of EELA inventory. This approach parallels and complements the standard used to assess the relationships between the number of adverse childhood experiences—better known as ACEs—and negative outcomes (e.g., Anda et al., 2006). The EELA inventory offers a significant methodological contribution to connect early-life exposure with late-life cognitive plasticity, and researchers investigating cognitive reserve, environmental enrichment, or protective factors can easily incorporate the EELA questions into prospective studies. The bias of retrospective recall for this measure was designed to be low by asking whether individuals engaged in these activities or not. Past research supports this approach as retrospective recall can be very accurate even after 50+ years (Berney & Blane, 1997) when the content is simple and concrete (i.e., devoid of emotion, retrospective impact bias; Wilson, Meyers, & Gilbert, 2003). In developmental research, cohort studies are still considered a gold standard, although they are susceptible to cohort effects. Science relies on replication as a vital process to corroborate toward understanding the "truth," thus both cohort studies and retrospective recall measures should be methodologies used to vet the connections between early-life activities and late-life outcomes. Simple and practical instruments to implement into research studies, such as the EELAs, help provide a proxy life-span approach to connecting early and late life (Berney & Blane, 1997). Moreover, implementing the EELA questionnaire in other samples may help determine whether a variety of activities in early life is predictive and protective in normative samples: does this relationship between early enrichment and later life cognition generalize to other samples which may not be at risk?

Ubiquitously, education has been an important indicator of cognitive reserve and functioning and subsequent resilience to cognitive declines and impairments late in life (Stern, 2002). Correspondingly, the current study's findings suggest engagement in more variety of activities in early life corresponds with greater educational attainment by late life. The current study's results expand on previous works in the larger BECT sample (Parisi et al., 2012) and offers evidence to support life-long plasticity and resilience of enriching exposures in youth both in-the-home (e.g., Bradley et al., 1989; Wilson et al., 2005) and outside-the-home (Gow et al., 2017). Our findings suggest that exposure to enriching environments early in life may help perpetuate the likelihood of ongoing opportunities for sociodemographically at-risk groups to build their developmental potential. Thus, the focus on understanding both adverse and enriched childhood experiences is suggested to be necessary to tackling and narrowing health disparities related to late-life cognitive resilience.

Prevention Intervention and Policy Implications

The current study's findings have intervention and policy implications from a life course perspective to assist in tackling the larger issue of health disparities. First, our findings provide further evidence suggesting that building cognitive reserve earlier in the life span may strengthen late-life cognitive functioning. Since African Americans are at greater risk of developing cognitive impairments in later life, understanding how to best intervene in early life is a key to taking a public health prevention approach to benefit future generations.

In support, interventions that have provided (predominately) African American children with enriching educational experiences, such as the Abecedarian Project and High/Scope Perry Preschool Program, have yielded favorable outcomes in educational attainment (Belfield, Nores, Barnett, & Schweinhart, 2006; Campbell et al., 2012). These exemplary interventions, however, concluded in early childhood (~age 5), are resource intensive, and focused exclusively on enrichment in the classroom setting. The current study's findings suggest that another promising avenue to promote cognitive reserve is through providing opportunities to engage in enriching activities outside the classroom; this suggests increasing investments toward positive youth development programs that provide a variety of enriching experiences (e.g., volunteering, team sports) put at-risk youth on greater growth, reserve, and resilience trajectories (see Catalano, Berglund, Ryan, Lonczak, & Hawkins, 2004).

Historically, however, local and national housing (e.g., Federal Housing Administration racial covenants) and educational policies (e.g., Plessy vs. Ferguson) have led to social disadvantages throughout the life course—that intervening with early-life enrichment does not address. Institutionalized-level policies experienced earlier in the life span, such as Brown vs. Board of Education (e.g., desegregated vs. segregated schools; Whitfield & Wiggins, 2003), have been linked to cognitive performance among older African Americans. Moreover, historical discriminatory policies have limited educational quality and early enrichment opportunities and have increased the likelihood of experiencing adverse childhood experiences, toxic stress responses due to exposures to accumulated stressors, poorer self-regulatory capacities (e.g., coping strategies), and stunted cognitive development (C. A. McEwen & B. S. McEwen, 2017) factors in route to downstream health disparities (Shonkoff, Boyce, & McEwen, 2009). Accordingly, investments in large-scale projects earlier in the life span, such as the Harlem Children Zone, aim to address some of these disadvantages by offering early-life support services concurrently with providing a variety of enrichment opportunities. Compared with the historical disadvantages experienced, these large-scale projects are postulated to be associated with favorable downstream educational achievement and subsequent cognitive functioning.

Limitations and Future Directions

Although this study's findings elucidated connections between early-life enrichment and late-life educational attainment and cognition, there are limitations ripe for future research to address. First, the measure of variety of early-life activities is retrospective, which is susceptible to recall bias. Additionally, the novelty of the EELA means that there is no measure of validity or reliability. Also, this study inventoried only seven items that were pertinent to this study's sample and did not capture EELA frequency (e.g., how long did you attend church) or intensity (e.g., how stimulating was going to church as a child?). Furthermore, prospective studies and future work could tailor EELAs and measure frequency of life activities such as quantifying years; however, designing frequency questions may break a cardinal rule of survey design by taxing the respondent to have an accurate, ready-made answer and provide appropriate time referents (Dillman, Smyth, & Christian, 2014). Second, participants were required to meet minimum standards for cognitive health (MMSE ≥24) and reading abilities (WRAT >43) to be considered for randomization in either the intergenerational reading mentoring intervention or the control conditions; this expands the need for the findings to be replicated in more sociodemographically at-risk cohorts. Likewise, future work should consider assessing educational quality (e.g., WRAT) as suggested by previous studies between quality and cognition in African American and historically underserved minority samples (e.g., Manly, Jacobs, Touradji, Small, & Stern, 2002; Whitfield & Wiggins, 2003).

Moreover, beyond demographic characteristics, investigating the underlying personality (e.g., openness) and motivational (e.g., need for cognition) variables may be future directions to understanding who is more likely to seek engagement in a variety of enriching experiences. Lastly, dementia and cognitive impairments were not explicitly measured, which will be important in this sample and others to better understand the role of early enrichment and cognitive declines or impairments as people age.

Conclusions

The approach and findings of the current study provide promising evidence that engagement in a variety of enriching childhood activities links with cognitive health and resilience. Realistically, however, merely providing at-risk groups more enriching environments are not going to be the panacea to quelling cognitive health disparities: as there are many real historical, societal, economic, and familial factors. Nevertheless, investigating both the adverse and enriching conditions of early-life exposures is necessary to improve the science and eventual interventions that support cognitive health throughout the life span for people who are most at risk—that is ACEs and EELAs. The current study's findings suggest that engaging in a variety of positive exposures in early life may keep the mind sharper later. Lastly, the cognitive reserve could be thought of like as an emergency savings account, it lays dormant, until something goes awry; those with more savings are able to stave off crisis (i.e., cognitive declines or diseases), while those with little reserve go into crisis quicker. For at-risk groups, the current study's findings suggest that investing in enrichment earlier in life are important to help build this emergency defense.

Supplementary Material

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

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Conflict of Interest

There are no conflicts of interests.

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