Developmental Psychology

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Online First Publication, September 29, 2022. http://dx.doi.org/10.1037/dev0001469

CITATION

Almeida, D. M., Rush, J., Mogle, J., Piazza, J. R., Cerino, E., & Charles, S. T. (2022, September 29). Longitudinal Change in Daily Stress Across 20 Years of Adulthood: Results From the National Study of Daily Experiences. *Developmental Psychology*. Advance online publication. http://dx.doi.org/10.1037/dev0001469

AMERICAN PSYCHOLOGICAL ASSOCIATION

Developmental Psychology

ISSN: 0012-1649

https://doi.org/10.1037/dev0001469

Longitudinal Change in Daily Stress Across 20 Years of Adulthood: Results From the National Study of Daily Experiences

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This study examined age-related patterns in exposure and affective reactivity to daily stressors across a 20-year time span among adults who were between 22 and 77 years old at their baseline interview. Longitudinal data from the National Study of Daily Experiences (NSDE) consisted of three bursts of eight consecutive nightly interviews of stress and affect. Analyses made use of all available data from a U.S. National sample of respondents who participated in any of the three NSDE bursts (N = 2,845; number of daily assessments = 33,688). Findings revealed increasing age-related benefits. Younger adults (<30 years) reported the highest levels of stressor exposure and reactivity, but their stress profile improved with age. Over time, adults averaged an 11% reduction in the occurrence of stressor days, and the younger adults exhibited an even steeper decline (a 47% reduction) in their levels of stressor reactivity. For people in midlife and old age, stressor occurrence continued to decrease over time, yet among adults aged 54 years or older at baseline, stress reactivity remained stable across time.

Keywords: adulthood, daily diary, daily stress, longitudinal design, negative affect

Every day, the news is filled with emotional accounts of life in the United States, from protests in the streets over political policy and social issues to economic uncertainty and concerns over the health and well-being of our families and the larger world. According to the Stress in America poll, which began documenting stress in the United States in 2007, levels of stress in America have reached an all-time high, with more than 80% of surveyed adults reporting emotional effects from prolonged stress (American Psychological Association, 2021). This uptick in stress is concerning; when considering psychological factors related to mental and physical health, few are as pervasive as stress. Decades of research have linked the stress response to multiple indices of physical and emotional health, ranging from depression, anxiety, and sleep disorders to cardiovascular disease, diminished recovery from cancer, higher rates of chronic disease, and earlier mortality (Charles et al., 2013; Chiang et al., 2018; Cohen et al., 2016; Piazza et al., 2010). Stress exacerbates almost every

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Since 1995 the Midlife in the United States Study has been funded by the following: John D. and Catherine T. MacArthur Foundation Research Network; National Institute on Aging (P01-AG020166); and National institute on Aging (U19-AG051426).

Data and documentation for all MIDUS projects are available to other researchers at the Inter-university Consortium for Political and Social Research (ICPSR). In addition to the publicly available data at ICPSR, a MIDUS-Colectica Portal (midus.colectica.org) contains rich searchable metadata, links to helpful documentation, and the ability to download customized datasets. Analytic methods specific to the current study are available on request from the corresponding author.

David M. Almeida served as lead for conceptualization, data curation, funding acquisition, investigation, supervision, writing–original draft, and writing–review and editing and contributed equally to formal analysis and methodology. Jonathan Rush served as lead for formal analysis and visualization, contributed equally to methodology and writing–original draft, and served in a supporting role for writing–review and editing. Jacqueline Mogle contributed equally to methodology and project administration and served in a supporting role for conceptualization, data curation, formal analysis, writing–original draft, and writing–review and editing. Jennifer R. Piazza served in a supporting role for conceptualization, investigation, writing–original draft, and writing–review and editing. Eric Cerino served in a supporting role for data curation, formal analysis, visualization, writing–original draft, and writing–review and editing. Susan T. Charles contributed equally to conceptualization, writing–original draft, and writing–review and editing and served in a supporting role for formal analysis and funding acquisition.

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chronic health condition, is fundamental to emotional well-being and overall quality of life, and is experienced at high rates by a majority of adults. Moreover, stress influences our biological aging, acting as a speedometer of our life span (for review, see Almeida et al., 2011; Harvanek et al., 2021).

Stress affects health, and these effects unfold every day of our lives. It has been proposed that chronic stress can best be understood and measured in patterns of acute stressors and responses (Smyth et al., 2013). For this reason, research has increasingly focused on the dynamics of stress in daily life, studying the naturally occurring events that trigger stress (i.e., stressors) and the emotional and behavioral sequalae of these events (i.e., stress responses). For the past two decades, we have studied how daily stressors—those minor but frequent occurrences arising out of normal day-to-day living, such as arguments with a spouse, pressing work deadlines, or one's child spiking a fever—disrupt daily life. Daily stressors have potent immediate effects on emotional (Stawski et al., 2008), physical (Hoffman & Stawski, 2009), neuroendocrine (Stawski et al., 2013), and cognitive (Sliwinski et al., 2006; Stawski et al., 2010) health, and accumulate to have long-term effects on mental (Charles et al., 2013) and physical (Piazza et al., 2013) health, as well as longevity (Chiang et al., 2018; Mroczek et al., 2015). This work distinguishes the occurrence of stressors (i.e., stressor exposure) from the emotions that they engender (i.e., stressor reactivity; Almeida, 2005; Bolger et al., 1989). Exposure is often assessed as the number of stressors encountered or the proportion of days individuals report having a stressful event, whereas reactivity is often characterized as the difference in negative or positive affect on stressor days versus nonstressor days. Both stressor exposure and reactivity are important features of health and well-being across the life course (Almeida et al., 2020), and a main feature of previous work has been to examine the extent to which daily stress is age-graded. Given that stress is highly correlated with health outcomes, understanding how the stress process relates to age and changes over time is necessary to identify the age groups most at risk for stress-related emotional and physical disorders.

Across successively older age groups, stressor frequency decreases with age (Aldwin et al., 2014; Almeida & Horn, 2004; Stawski et al., 2008), a pattern that can be partially explained by differing goals and life tasks common at each life stage. In young adulthood, common developmental tasks include gaining educational and occupational skills, achieving financial independence, and cultivating adult social networks. These tasks entail challenges and struggles that are often accompanied with daily stressors. Over time, career trajectories may become more stable. Family and work responsibilities may give rise to daily stressors, although generally not at the level observed by younger adults. In older adulthood, decreased social roles and expectations associated with retirement and empty nests, coupled with greater leisure time, may explain lower levels of daily stressors (Bossé et al., 1991).

Social roles and life tasks, however, may not be sufficient to explain age-related decreases in daily stressors. Even among older adults ranging from their mid-60s to their 90s, age is still related to lower levels of daily stressors (Charles et al., 2010). Another contributing factor may be related to a development shift where older age is associated with an increased preference for positive over negative stimuli, referred to as the positivity effect (Carstensen & Mikels, 2005). The positivity effect describes why older adults often perceive and remember situations less negatively than their younger counterparts, which may perhaps decrease the likelihood of them remembering a daily event as something that warrants the label of a stressor (e.g., Aldwin et al., 1996).

The finding that stressors decrease in frequency with age in cross-sectional studies is robust and replicated in studies examining groups of adults representing most of the entire adult life span, or just among samples of middle-aged and/or older adults (Aldwin et al., 2014; Charles et al., 2010). With respect to stressor reactivity, however, the pattern of cross-sectional age differences has been mixed (Schilling & Diehl, 2015), at times showing the expected age-related decreases (Birditt, 2014; Charles et al., 2009; Scott et al., 2013, 2017; Uchino et al., 2006), but also no significant age-related differences (Diehl & Hay, 2010; Schilling & Diehl, 2014; Stawski et al., 2008) and even the opposite pattern of age-related increases in stressor reactivity (Sliwinski et al., 2009; Wrzus et al., 2013, 2015). For example, Sliwinski et al. (2009) found that affective reactivity to daily stressors in samples of midlife (25–74) and older (65–95) adults increased longitudinally over 2.5- and 10-year periods. Meanwhile, Schilling and Diehl (2014) found that increased age was associated with reduced impact of accumulated stressor exposure (i.e., pile-up). A recent coordinated analysis of seven daily studies reflects this varied pattern, showing some, but not universal, evidence for age-related decrements in stressor reactivity (Stawski et al., 2019).

Given the importance of stress on our health and well-being, the current study followed the 20-year trajectory of two aspects of stress—the occurrence/exposure of stressors and emotional reactivity to these stressors—among a large national sample of adults across three time points. Many of the previous studies on age patterns of daily stress have been limited by age ranges and limited longitudinal time spans (Almeida & Horn, 2004; Diehl & Hay, 2010; Stawski et al., 2008, 2019), which may be part of the reason for the discrepant findings. The current study is the first look into age patterns in exposure and affective reactivity to daily stressors across a long (20-year) time span on a wide age range of adults who were between 22 and 77 at their baseline interview. Given the descriptive nature of the analyses, we did not preregister the hypotheses. We use cross-sectional and longitudinal data from the National Study of Daily Experiences (NSDE) to examine changes in exposure and reactivity to daily stress across 20 years and how they may differ across the life span.

Method

Participants and Procedure

Participants were from the NSDE, a random subset of participants invited from the larger Midlife in the United States (MIDUS) project (https://www.icpsr.umich.edu/web/ICPSR/series/203). The study was approved by the IRB of the institution responsible for data collection, and all respondents consented to their participation. Individuals who consented to participate responded to end-of-day telephone interviews for eight consecutive days that assessed daily levels of stress and affect (for a detailed description of data collection, see Almeida, 2005; Almeida et al., 2009). The NSDE data collection consisted of three bursts of daily assessments repeated at approximately 9-year intervals, providing longitudinal daily diary data across 20 years of adulthood (NSDE 1: ∼1996; NSDE 2: ∼2005; NSDE 3: ∼2017). Daily diary data was collected on a total of 33,688 days of 37,576 possible days (completion rate = 90%). The current research made use of all available data from respondents who participated in any of the three NSDE bursts (*N* = 2,845; number of daily assessments = 33,688; 1,429 participants completed two or more bursts).

NSDE Daily Diary Measures

Daily Stressors

Daily stressors were assessed using the Daily Inventory of Stressful Events (DISE; Almeida et al., 2002). The inventory consisted of six questions inquiring whether certain types of stressors had been experienced in the last 24 hours (i.e., *arguments*, *avoided arguments*, *work overloads*, *home overloads*, *network stressors*, *other*). A dichotomous variable was used to characterize days as either stress days (at least one stressor was reported) or nonstress days (no stressor reported). A daily stressor was reported on 39% of all available days. Two-thirds of the participants reported that the daily assessment period was "about the same as a typical week" in terms of stressfulness, whereas 15% indicated that the week was more stressful than a typical week, and 18% indicated that it was less stressful. Overall, the eight-day daily assessment period appeared to adequately capture a typical week for participants.

Negative Affect

Daily negative affect was assessed during each burst of the NSDE data collections. Participants were presented with a list of six emotions (*fidgety*, *nervous*, *worthless*, *so sad that nothing could cheer you up*, *everything was an effort*, and *hopeless*; Mroczek & Kolarz, 1998) and asked to indicate how frequently they felt each emotion in the past 24 hours. Responses ranged from 0 (*none of the time*) to 4 (*all of the time*). Daily negative affect scores were computed by averaging across the items. Multilevel omega was used to estimate within- and between-person reliability (see Geldhof et al., 2014). Within-person reliability estimates were .60, .58, and .54 for bursts 1, 2 and 3, respectively. Between-person reliability was .81, .82, and .82 for bursts 1, 2, and 3, respectively.

Covariates

Participant age at NSDE baseline, sex, education, and race were included as covariates to adjust for sample heterogeneity. Age at baseline was grouped into five-year bins (<30; 31–35; 36–40; 41–45; 46–50; 51–55; 56–60; 61–65; 66–70; >70). Sex, education, and race were coded as dichotomous variables (0 = *male*, 1 = *female*; 0 = *high school or less*, 1 = *some college or more*, and 0 = *white*, 1 = *not white*, respectively). Each of the covariates was centered at the grand mean in all statistical models.

Data Analytic Strategy

Separate multilevel modeling analyses were used to examine changes in daily stressor exposure and stressor reactivity across 20 years of longitudinal data. Daily measurement occasions were nested within measurement bursts and measurement bursts were nested within people, resulting in three levels of analysis.

Stressor Exposure Change

Stressor exposure was defined as the proportion of days within each burst that a stressor was reported. Changes in stressor exposure was estimated with the following equation:

$$\text{Level 1: } Y_{ijk} = \pi_{0ij} + e_{ijk} \tag{1a}$$

$$\text{Level 2: } \pi_{0ij} = \beta_{00i} + \beta_{01i}(Burst_{ij}) + r_{0ij} \tag{1b}$$

$$\text{Level 3: } \beta_{00i} = \gamma_{000} + \gamma_{001}(Age.BL_i) + \gamma_{002}(Sex_i) + \gamma_{003}(College_i) + \gamma_{004}(Race_i) + u_{00i} \tag{1c}$$

$$\beta_{01i} = \gamma_{010} + \gamma_{011}(Age.BL_i) + u_{01i} \tag{1d}$$

The within-burst stress exposure estimate (π_{0ij}) was regressed on $Burst_{ij}$ (coded 0, 1, or 2) to provide an estimate of macrolongitudinal change in stressor exposure across bursts, β_{01i} (between-burst, Level 2). Age at baseline ($Age.BL_i$), Sex_i, $College_i$, and $Race_i$ were included as between-person (Level 3) covariates to adjust for differences in baseline levels of stress exposure. Age at baseline was also included as a between-person moderator of changes in stressor exposure (i.e., γ_{011}).

Stressor Reactivity Change

Stressor reactivity was defined as the difference in NA on days when a stressor was reported compared with days when a stressor was not reported and specified at the within-burst level (Level 1). Changes in stressor reactivity were estimated with the following equation:

$$\text{Level 1: } NA_{ijk} = \pi_{0ij} + \pi_{1ij}(Stress.day_{ijk}) + e_{ijk} \tag{2a}$$

$$\text{Level 2: } \pi_{0ij} = \beta_{00i} + \beta_{01i}(Burst_{ij}) + \beta_{02i}(\overline{Stress.day_{ij}}) + r_{0ij} \tag{2b}$$

$$\pi_{1ij} = \beta_{10i} + \beta_{11i}(Burst_{ij}) + r_{1ij} \tag{2c}$$

$$\text{Level 3: } \beta_{00i} = \gamma_{000} + \gamma_{001}(Age.BL_i) + \gamma_{002}(Sex_i) + \gamma_{003}(College_i) + \gamma_{004}(Race_i) + u_{00i} \tag{2d}$$

$$\beta_{01i} = \gamma_{010} \tag{2e}$$

$$\beta_{02i} = \gamma_{020} \tag{2f}$$

$$\beta_{10i} = \gamma_{100} + \gamma_{101}(Age.BL_i) + \gamma_{102}(Sex_i) + \gamma_{103}(College_i) + \gamma_{104}(Race_i) + u_{10i} \tag{2g}$$

$$\beta_{11i} = \gamma_{110} + \gamma_{111}(Age.BL_i) + u_{11i} \tag{2h}$$

The within-burst stress reactivity estimate (π_{1ij}) was regressed on $Burst_{ij}$ (coded 0, 1, or 2) to provide an estimate of macrolongitudinal change in stressor reactivity across bursts, β_{11i} (between-burst, Level 2). Age at baseline (*Age.BL*), *Sex*, *College*, and *Race* were included as between-person (Level 3) covariates predicting

Table 1

Means, Standard Deviations, and Range Among Study Variables

Variable	Burst 1 (N = 1,499)			Burst 2 (N = 2,022)			Burst 3 (N = 1,176)		
	M	SD	Range	M	SD	Range	M	SD	Range
Age	48.20	12.84	22−77	58.61	12.12	35−86	67.67	10.34	47−95
Sex[a]	.53	0.50	0−1	.57	0.49	0−1	.57	0.49	0−1
College[b]	.65	0.48	0−1	.69	0.46	0−1	.75	0.43	0−1
Race[c]	.10	0.29	0−1	.15	0.36	0−1	.14	0.34	0−1
Daily negative affect[d,f]	0.18	0.29	0−3.39	0.20	0.31	0−3.08	0.17	0.25	0−2.92
Daily stressors[e,f]	.39	0.26	0−1	.40	0.27	0−1	.39	0.28	0−1

[a]Proportion of female participants. [b] Proportion of participants with some college. [c] Proportion of nonwhite participants. [d] Aggregated across persons. [e] Proportion of stress days across persons. [f] Daily variables were initially aggregated across days and then again across persons to create between-person averages of stressor exposure and negative affect; 1,429 participants completed 2+ bursts.

baseline levels of negative affect (i.e., γ_{001}, γ_{002}, γ_{003}, and γ_{004}, respectively) and stress reactivity (i.e., γ_{101}, γ_{102}, γ_{103}, and γ_{104}, respectively). Age at baseline was also included as a between-person moderator of changes in stressor reactivity (i.e., γ_{111}). All models were estimated in Mplus v8.5 (Muthén & Muthén, 2017) using full information maximum likelihood with robust standard errors (MLR).

Results

Descriptive statistics at each burst of daily assessments are included in Table 1. Participants ranged in age from 22–77 years (M = 48.2, SD = 12.8) at baseline and 47–95 years (M = 67.7, SD = 10.3) at the third burst of assessment. Just over half of the participants were women (56%) and a majority (67%) had completed at least some college education. Across the bursts of assessment, participants reported relatively low levels of daily negative affect and experienced at least one stressor on approximately 40% of the study days.

Stressor Exposure

Changes in stressor exposure are presented in Table 2. On average individuals declined in the proportion of stress days reported across the 20-year period (γ_{010} = −.022, p < .001). By the third burst, stressor exposures had declined by 11% compared with baseline levels. Furthermore, cross-sectional age differences indicated that older adults at baseline reported fewer stress days than younger adults (γ_{001} = −.020, p < .001). For example, the proportion of stress days reported by individuals >70 years old at baseline was estimated to be 25% fewer than individuals 46–50 years old at baseline. Both the longitudinal age changes and the cross-sectional age differences in stress exposure are illustrated in Figure 1A.

Age at baseline did not moderate the longitudinal changes in stressor exposure (γ_{011} = −.002, p = .400). That is, older adults did not significantly differ from younger adults in the rate of decline in stressor exposure. Figure 1B displays the simple slope of longitudinal stress exposure changes at varying

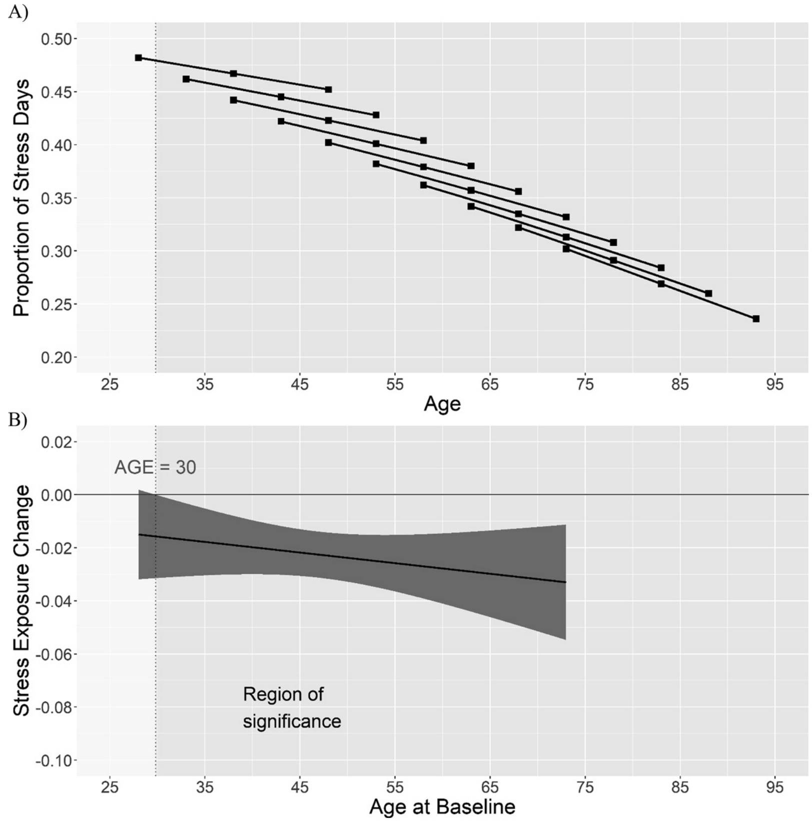
Table 2

Multilevel Modeling Analyses of the Longitudinal Changes in Daily Stressor Exposure Across 20 Years

Variable	Estimate (SE)	p value	95% CI
Fixed effects			
Within-burst variables (Level 1)			
Stress exposure intercept (γ_{000})	0.400 (.006)	<.001	[0.389, 0.411]
Between-burst variables (Level 2)			
Stress exposure change (γ_{010})	−0.022 (.004)	<.001	[−0.030, −0.013]
Between-person variables (Level 3)			
Sex (γ_{002})	0.048 (.009)	<.001	[0.031, 0.065]
College (γ_{003})	0.099 (.009)	<.001	[0.081, 0.116]
Race (γ_{004})	−0.045 (.012)	<.001	[−0.070, −0.021]
Age at baseline (γ_{001})	−0.020 (.002)	<.001	[−0.025, −0.016]
Stress Exposure Change × Age at Baseline (γ_{011})	−0.002 (.002)	.400	[−0.005, 0.002]
Random effects			
Within-person residual (σ_e^2)	0.195 (.002)	<.001	[0.192, 0.198]
Between-burst			
Stress exposure (σ_{r0}^2)	0.005 (.001)	<.001	[0.003, 0.008]
Between-person			
Stress exposure (σ_{u00}^2)	0.028 (.002)	<.001	[0.025, 0.031]
Stress exposure change (σ_{u01}^2)	0.003 (.001)	<.001	[0.001, 0.004]

Note. Results are based on 33,688 daily assessments (N = 2,845). CI = confidence interval. Sex (0 = male; 1 = female). College (high school or less = 0; some college or more = 1). Race (white = 0; not white = 1). Estimates of fixed effects are reported as unstandardized regression coefficients. Estimates of random effects are reported as variances.

Figure 1
Longitudinal Change in Stressor Exposure



Note. (A) Longitudinal age changes and cross-sectional age differences in stressor exposure across adulthood. (B) Johnson-Neyman plot to identify regions of significance. The simple slope of stress exposure change is shown across varying ages at baseline (thick black line). The gray bands represent the 95% confidence interval that can be used to infer statistical significance. When the horizontal zero line is included in the confidence bands, the simple slope is not statistically significant at that age. The vertical hatched line denotes the boundary age where longitudinal change in stress exposure is statistically significant.

baseline ages. For individuals over 30 years old at baseline, stress exposure significantly declined across the 20-year follow-up. Differences in baseline levels of stress exposure were also detected for sex, education, and race. Females reported more stress days than males; individuals with some college reported more stress days than those who completed high school or less; and white participants reported more stress days than nonwhite participants.

Stressor Reactivity

Table 3 presents the results of the multilevel model examining changes in stressor reactivity. Consistent with much previous research (Stawski et al., 2019), a significant stress reactivity estimate was established. On days when a stressor was reported, participants reported higher NA compared with days when a stressor was not reported (γ_{100} = .139, $p < .001$). Longitudinal changes in stressor reactivity indicated that on average individuals declined in their reactivity to stressors across 20 years of follow-up ($\gamma_{110} = -.017$, $p = .002$). Individuals at the sample mean age (i.e., 46–50 years old) at baseline were estimated to be 24% less reactive to daily stressors at the 20-year follow-up relative to their baseline levels. Cross-sectional age differences also emerged, such that older adults at baseline were less reactive to daily stressors compared with younger adults ($\gamma_{101} = -.010$, $p <$ .001). Individuals 66–70 years old at baseline were estimated to be 29% less reactive to daily stressors than individuals 46–50 years old at baseline.

Importantly, age at baseline significantly moderated changes in stress reactivity (γ_{111} = .006, $p = .011$). Figure 2A illustrates how younger adults declined more rapidly longitudinally across time in their reactivity to daily stressors compared with older adults. The Johnson-Neyman technique was applied to identify the ages where individuals were significantly changing in stressor reactivity. As displayed in Figure 2B, individuals younger than age 54 at baseline were significantly declining in stressor reactivity, whereas individuals older than 54 did not significantly decline across time. Furthermore, around age 65 at baseline,

Table 3
Multilevel Modeling Analyses of the Longitudinal Changes in Daily Stressor Reactivity Across 20 Years

Variable	Estimate (*SE*)	*p* value	95% CI
Fixed effects			
Within-burst variables (Level 1)			
NA intercept (γ_{000})	0.064 (.007)	<.001	[0.050, 0.079]
Stress reactivity intercept (γ_{100})	0.139 (.007)	<.001	[0.125, 0.153]
Between-burst variables (Level 2)			
Burst-mean stress (γ_{020})	0.172 (.017)	<.001	[0.139, 0.205]
NA change (γ_{010})	0.011 (.003)	.002	[0.004, 0.018]
Stress reactivity change (γ_{110})	−0.017 (.006)	.002	[−0.028, −0.006]
Between-person variables (Level 3)			
Sex (γ_{002})	−0.002 (.008)	.798	[−0.018, 0.014]
College (γ_{003})	−0.066 (.009)	<.001	[−0.084, −0.048]
Race (γ_{004})	0.086 (.015)	<.001	[0.057, 0.116]
Age at baseline (γ_{001})	0.001 (.002)	.736	[−0.003, 0.004]
Stress Reactivity × Sex (γ_{102})	0.024 (.009)	.005	[0.007, 0.041]
Stress Reactivity × College (γ_{103})	−0.052 (.011)	<.001	[−0.074, −0.031]
Stress Reactivity × Race (γ_{104})	0.016 (.015)	.292	[−0.014, 0.045]
Stress Reactivity × Age at Baseline (γ_{101})	−0.010 (.003)	<.001	[−0.016, −0.005]
Stress Reactivity Change × Age at Baseline (γ_{111})	0.006 (.002)	.011	[0.001, 0.010]
Random effects			
Within-person NA (σ_e^2)	0.054 (.002)	<.001	[0.050, 0.058]
Between-burst			
NA (σ_{r0}^2)	0.014 (.003)	<.001	[0.009, 0.019]
Stress reactivity (σ_{r1}^2)	0.023 (.004)	<.001	[0.016, 0.030]
Between-person			
NA (σ_{u00}^2)	0.032 (.006)	<.001	[0.021, 0.043]
Stress reactivity (σ_{u10}^2)	0.012 (.005)	.007	[0.003, 0.021]
Stress reactivity change (σ_{u11}^2)	0.000 (.004)	.976	[−0.008, 0.008]

Note. Results are based on 33,688 daily assessments (N = 2,845). CI = confidence interval; NA= negative affect. Sex (0 = male; 1 = female). College (high school or less = 0; some college or more = 1). Race (white = 0; not white = 1). Estimates of fixed effects are reported as unstandardized regression coefficients. Estimates of random effects are reported as variances.

individuals demonstrated slight (but nonsignificant) longitudinal increases in stressor reactivity.

In addition to the primary age-related effects, sex and education also accounted for differences in baseline levels of stress reactivity. Females were more reactive to daily stressors compared with males, whereas individuals with some college were less reactive to daily stressors compared with those who completed high school or less.

Discussion

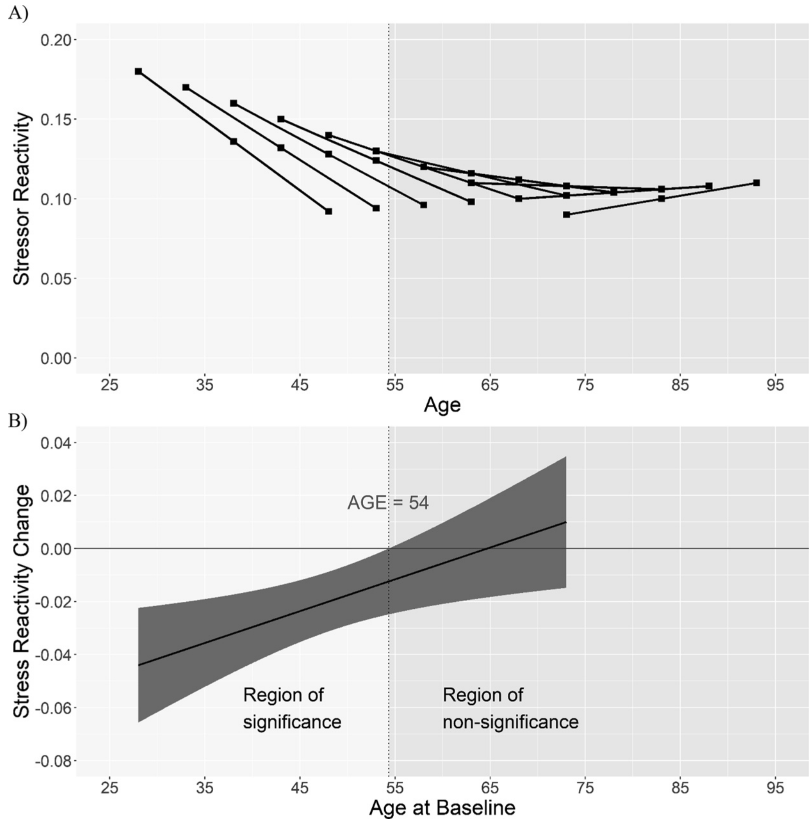
Stress is a contributing factor to many mental and physical health conditions (Yaribeygi et al., 2017). Given how important it is to life span health and well-being, the current study examined how two aspects of stress—exposure to stressors and affective reactivity to these stressors—change over a 20-year time span among a large national sample of adults who were interviewed across three time points. Findings overall reveal a clear and robust benefit with age. Younger adults have the highest levels of stress—both in terms of stressor exposure and reactivity—compared with any other age group. Yet, their stress profile improves as they age, with adults reporting, on average, an 11% reduction in the occurrence of stressor days over time and younger adults exhibiting the steepest declines (47% reduction) in levels of stressor reactivity. For people in their mid-50s and older, however, stressor occurrence continues to decrease over time, yet stress reactivity remains stable across time.

Daily Stressor Occurrence

Both cross-sectional and longitudinal results reveal the same age-related pattern: daily stressors are most prevalent in young adulthood and steadily decrease in number with age. The proportion of stressor days reported by older adults are 25% fewer than middle-aged adults and 38% fewer than the youngest adults. Although this study did not test any underlying mechanisms to explain these age benefits, findings are consistent with a number of sociological and psychological theories. Life stage models of development describe the patterns of behavior typical of each life stage. Young adulthood is a time of constant role changes, with people starting careers, navigating financial independence, and often establishing families. Younger adults report more major life events than middle-aged and older adults (Hughes et al., 1988), and daily stressors generally accompany these major life transitions (Almeida & Wong, 2009). Perhaps for older adults, retirement, independent children, and less active lifestyles (e.g., Lee et al., 2018) may partially account for the fewer stressors they experience compared with middle-aged and younger adults.

In addition to this life course model, the socioemotional selectivity theory posits that time perspective is linearly associated with age, and the greater awareness of the finitude of life leads people to place increasingly greater emphasis on emotionally meaningful goals. As a result, older adults often appraise their lives less negatively and more positively, a phenomenon known as the positivity

Figure 2
Longitudinal Change in Stressor Reactivity



Note. (A) Longitudinal age changes and cross-sectional age differences in stressor reactivity across adulthood. (B) Johnson-Neyman plot to identify regions of significance. The simple slope of stress reactivity change is shown across varying Age at baseline (thick black line). The gray bands represent the 95% confidence interval that can be used to infer statistical significance. When the horizontal zero line is included in the confidence bands, the simple slope is not statistically significant at that age. The vertical hatched line denotes the boundary age where longitudinal change in stress reactivity is no longer statistically significant.

effect (Carstensen & Mikels, 2005; Reed & Carstensen, 2012). With age, then, people may be more likely to seek positive situations and avoid unnecessary sources of stressors.

Stressor Reactivity

Changes in life perspectives may also play a role in the age-related reduction of affective reactivity to stressors we observed across younger adulthood and into midlife. Appraisals are strongly related to stress responses (Lazarus, 2000), and older adults perceive equally objectively severe stressors as less threatening than do younger adults (Aldwin, 2007). With age, researchers posit that people grow increasingly better at regulating their emotions by proactively avoiding stressors (Charles et al., 2010), and this decreased reactivity may reflect increases in antecedent emotion regulatory skills.

Yet, the age-related declines in stressor reactivity are not as linear as the findings for stressor occurrence. Starting in the midst of midlife (estimated around 54 years old), people were stable in their stressor reactivity across 20 years. Again, we did not test mechanisms explaining why the decline in reactivity ceases at this time. One possibility is that a stressor, by definition, is usually associated with some degree of reactivity, and by midlife people have reached a low level of reactivity that cannot decline further (i.e., the floor effect). Another possibility is that although older adults may be more adept at avoiding the presence of stressors, they may not be more adept at regulating the high levels of distress that stressors elicit. Strength and Vulnerability Integration (SAVI) states that age-related changes in physiology may create difficulties down-modulating higher levels of distress. As a result, this model posits that older adults will report fewer stressors, but may not exhibit age-related reductions in reactivity when stressors do occur.

Limitations and Future Directions

Of course, the strengths of this study must be interpreted alongside its limitations. Stressors were assessed through self-reports at the end of the day, and not by collecting objective measures of these events. As such, we rely on how people appraise and remember their stressors, and these appraisals and memory requirements may be affected by age. These limitations were offset by the large number of people capturing naturalistic stress processes that occur in daily life. Another major limitation is the lack of diversity in racial and ethnic composition of the sample, and the lack of people who fall in the lowest socioeconomic stratum of America (who are arguably most vulnerable to the effects of daily stress). In addition, younger adults at the bottom of the adult age spectrum (ages 18–22) were not included in NSDE and only a small number of the oldest old (e.g., those who are 90 years and older) were represented. We acknowledge that our results may not generalize to understudied groups. With the population increasingly becoming socioeconomically, racially, and ethnically diverse, and living longer than ever, studying how changes vary by these critical demographic dimensions is an ethical and scientific necessity.

Conclusion

Stress is a speedometer of our life course. Stress permeates our daily lives and plays an important role in psychological health, chronic conditions, and even mortality. Given its pernicious effects, an important question is, how do individuals experience stress as they age? Using our large U.S. national sample with 20 years of longitudinal data, we show that age confers some benefits in terms of decreased exposure and emotional reactivity to daily stressors. Although stress might accelerate the aging processes, growing older may also allow us to lead less stressful lives.

References

Aldwin, C. M. (2007). *Stress, coping, and development: An integrative perspective*. Guilford Press.

Aldwin, C. M., Jeong, Y.-J., Igarashi, H., & Spiro, A., III (2014). Do hassles and uplifts change with age? Longitudinal findings from the VA normative aging study. *Psychology and Aging*, *29*(1), 57–71. https://doi.org/10.1037/a0035042

Aldwin, C. M., Sutton, K. J., Chiara, G., & Spiro, A. I. I. I. (1996). Age differences in stress, coping, and appraisal: Findings from the Normative Aging Study. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, *51*(4), 179–188. https://doi.org/10.1093/geronb/51B.4.P179

Almeida, D. M. (2005). Resilience and vulnerability to daily stressors assessed via diary methods. *Current Directions in Psychological Science*, *14*(2), 64–68. https://doi.org/10.1111/j.0963-7214.2005.00336.x

Almeida, D. M., & Horn, M. C. (2004). Is daily life more stressful during middle adulthood. In O. G. Brim, C. D. Ryff, & R. C. Kessler (Eds.), *How healthy are we* (pp. 425–451). University of Chicago Press. https://doi.org/10.1037/e316982004-001

Almeida, D. M., & Wong, J. D. (2009). Life transitions and daily stress processes. In G. H. Elder, Jr., J. Z. Giele (Eds.), *The craft of life course research* (pp. 141–162). Guilford Press.

Almeida, D. M., Charles, S. T., Mogle, J., Drewelies, J., Aldwin, C. M., Spiro, A., III,., & Gerstorf, D. (2020). Charting adult development through (historically changing) daily stress processes. *American Psychologist*, *75*(4), 511–524. https://doi.org/10.1037/amp0000597

Almeida, D. M., McGonagle, K., & King, H. (2009). Assessing daily stress processes in social surveys by combining stressor exposure and salivary cortisol. *Biodemography and Social Biology*, *55*(2), 219–237. https://doi.org/10.1080/19485560903382338

Almeida, D. M., Piazza, J. R., Stawski, R. S., & Klein, L. C. (2011). The speedometer of life: Stress, health and aging. In K. W. Schaie & S. L. Willis (Eds.), *Handbook of the psychology of aging* (pp. 191–206). Academic Press. https://doi.org/10.1016/B978-0-12-380882-0.00012-7

Almeida, D. M., Wethington, E., & Kessler, R. C. (2002). The daily inventory of stressful events: An interview-based approach for measuring daily stressors. *Assessment*, *9*(1), 41–55. https://doi.org/10.1177/1073191102091006

American Psychological Association. (2021, October 26) *Stress and decision-making during the pandemic* [Press release]. https://www.apa.org/news/press/releases/stress/2021/october-decision-making

Birditt, K. S. (2014). Age differences in emotional reactions to daily negative social encounters. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, *69*(4), 557–566. https://doi.org/10.1093/geronb/gbt045

Bolger, N., DeLongis, A., Kessler, R. C., & Schilling, E. A. (1989). Effects of daily stress on negative mood. *Journal of Personality and Social Psychology*, *57*(5), 808–818. https://doi.org/10.1037/0022-3514.57.5.808

Bossé, R., Aldwin, C. M., Levenson, M. R., & Workman-Daniels, K. (1991). How stressful is retirement? Findings from the Normative Aging Study. *Journal of Gerontology*, *46*(1), P9–P14. https://doi.org/10.1093/geronj/46.1.P9

Carstensen, L. L., & Mikels, J. A. (2005). At the intersection of emotion and cognition: Aging and the positivity effect. *Current Directions in Psychological Science*, *14*(3), 117–121. https://doi.org/10.1111/j.0963-7214.2005.00348.x

Charles, S. T., Luong, G., Almeida, D. M., Ryff, C., Sturm, M., & Love, G. (2010). Fewer ups and downs: Daily stressors mediate age differences in negative affect. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, *65B*(3), 279–286. https://doi.org/10.1093/geronb/gbq002

Charles, S. T., Piazza, J. R., Luong, G., & Almeida, D. M. (2009). Now you see it, now you don't: Age differences in affective reactivity to social tensions. *Psychology and Aging*, *24*(3), 645–653. https://doi.org/10.1037/a0016673

Charles, S. T., Piazza, J. R., Mogle, J., Sliwinski, M. J., & Almeida, D. M. (2013). The wear and tear of daily stressors on mental health. *Psychological Science*, *24*(5), 733–741. https://doi.org/10.1177/0956797612462222

Chiang, J. J., Turiano, N. A., Mroczek, D. K., & Miller, G. E. (2018). Affective reactivity to daily stress and 20-year mortality risk in adults with chronic illness: Findings from the National Study of Daily Experiences. *Health Psychology*, *37*(2), 170–178. https://doi.org/10.1037/hea0000567

Cohen, S., Gianaros, P. J., & Manuck, S. B. (2016). A stage model of stress and disease. *Perspectives on Psychological Science*, *11*(4), 456–463. https://doi.org/10.1177/1745691616646305

Diehl, M., & Hay, E. L. (2010). Risk and resilience factors in coping with daily stress in adulthood: The role of age, self-concept incoherence, and personal control. *Developmental Psychology*, *46*(5), 1132–1146. https://doi.org/10.1037/a0019937

Geldhof, G. J., Preacher, K. J., & Zyphur, M. J. (2014). Reliability estimation in a multilevel confirmatory factor analysis framework. *Psychological Methods*, *19*(1), 72–91. https://doi.org/10.1037/a0032138

Harvanek, Z. M., Fogelman, N., Xu, K., & Sinha, R. (2021). Psychological and biological resilience modulates the effects of stress on epigenetic aging. *Translational Psychiatry*, *11*(1), Article 601. https://doi.org/10.1038/s41398-021-01735-7

Hoffman, L., & Stawski, R. S. (2009). Persons as contexts: Evaluating between-person and within-person effects in longitudinal analysis. *Research in Human Development*, *6*(2–3), 97–120. https://doi.org/10.1080/15427600902911189

Hughes, D. C., Blazer, D. G., & George, L. K. (1988). Age differences in life events: A multivariate controlled analysis. *International Journal of*

Aging & Human Development, *27*(3), 207–220. https://doi.org/10.2190/F9RP-8V9D-CGH7-2F0N

Lazarus, R. S. (2000). Toward better research on stress and coping. *American Psychologist*, *55*(6), 665–673. https://doi.org/10.1037/0003-066X.55.6.665

Lee, S., Koffer, R. E., Sprague, B. N., Charles, S. T., Ram, N., & Almeida, D. M. (2018). Activity diversity and its associations with psychological well-being across adulthood. *Journal of Gerontology*, *73*(6), 985–995. https://doi.org/10.1093/geronb/gbw118

Mroczek, D. K., & Kolarz, C. M. (1998). The effect of age on positive and negative affect: A developmental perspective on happiness. *Journal of Personality and Social Psychology*, *75*(5), 1333–1349. https://doi.org/10.1037/0022-3514.75.5.1333

Mroczek, D. K., Stawski, R. S., Turiano, N. A., Chan, W., Almeida, D. M., Neupert, S. D., & Spiro, A. I. I. I. (2015). Emotional reactivity and mortality: Longitudinal findings from the VA Normative Aging Study. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, *70*(3), 398–406. https://doi.org/10.1093/geronb/gbt107

Muthén, L. K., & Muthén, B. O. (2017). *Mplus user's guide*.

Piazza, J. R., Almeida, D. M., Dmitrieva, N. O., & Klein, L. C. (2010). Frontiers in the use of biomarkers of health in research on stress and aging. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, *65*(5), 513–525. https://doi.org/10.1093/geronb/gbq049

Piazza, J. R., Charles, S. T., Sliwinski, M. J., Mogle, J., & Almeida, D. M. (2013). Affective reactivity to daily stressors and long-term risk of reporting a chronic physical health condition. *Annals of Behavioral Medicine*, *45*(1), 110–120. https://doi.org/10.1007/s12160-012-9423-0

Reed, A. E., & Carstensen, L. L. (2012). The theory behind the age-related positivity effect. *Frontiers in Psychology*, *3*, Article 339. https://doi.org/10.3389/fpsyg.2012.00339

Schilling, O. K., & Diehl, M. (2014). Reactivity to stressor pile-up in adulthood: Effects on daily negative and positive affect. *Psychology and Aging*, *29*(1), 72–83. https://doi.org/10.1037/a0035500

Schilling, O. K., & Diehl, M. (2015). Psychological vulnerability to daily stressors in old age: Results of short-term longitudinal studies. *Zeitschrift Für Gerontologie Und Geriatrie*, *48*(6), 517–523. https://doi.org/10.1007/s00391-015-0935-7

Scott, S. B., Ram, N., Smyth, J. M., Almeida, D. M., & Sliwinski, M. J. (2017). Age differences in negative emotional responses to daily stressors depend on time since event. *Developmental Psychology*, *53*(1), 177–190. https://doi.org/10.1037/dev0000257

Scott, S. B., Sliwinski, M. J., & Blanchard-Fields, F. (2013). Age differences in emotional responses to daily stress: The role of timing, severity, and global perceived stress. *Psychology and Aging*, *28*(4), 1076–1087. https://doi.org/10.1037/a0034000

Sliwinski, M. J., Almeida, D. M., Smyth, J., & Stawski, R. S. (2009). Intraindividual change and variability in daily stress processes: Findings from two measurement-burst diary studies. *Psychology and Aging*, *24*(4), 828–840. https://doi.org/10.1037/a0017925

Sliwinski, M. J., Smyth, J. M., Hofer, S. M., & Stawski, R. S. (2006). Intraindividual coupling of daily stress and cognition. *Psychology and Aging*, *21*(3), 545–557. https://doi.org/10.1037/0882-7974.21.3.545

Smyth, J., Zawadzki, M., & Gerin, W. (2013). Stress and disease: A structural and functional analysis. *Social and Personality Psychology Compass*, *7*(4), 217–227. https://doi.org/10.1111/spc3.12020

Stawski, R. S., Almeida, D. M., Lachman, M. E., Tun, P. A., & Rosnick, C. B. (2010). Fluid cognitive ability is associated with greater exposure and smaller reactions to daily stressors. *Psychology and Aging*, *25*(2), 330–342. https://doi.org/10.1037/a0018246

Stawski, R. S., Cichy, K. E., Piazza, J. R., & Almeida, D. M. (2013). Associations among daily stressors and salivary cortisol: Findings from the National Study of Daily Experiences. *Psychoneuroendocrinology*, *38*(11), 2654–2665. https://doi.org/10.1016/j.psyneuen.2013.06.023

Stawski, R. S., Scott, S. B., Zawadzki, M. J., Sliwinski, M. J., Marcusson-Clavertz, D., Kim, J., Lanza, S. T., Green, P. A., Almeida, D. M., & Smyth, J. M. (2019). Age differences in everyday stressor-related negative affect: A coordinated analysis. *Psychology and Aging*, *34*(1), 91–105. https://doi.org/10.1037/pag0000309

Stawski, R. S., Sliwinski, M. J., Almeida, D. M., & Smyth, J. M. (2008). Reported exposure and emotional reactivity to daily stressors: The roles of adult age and global perceived stress. *Psychology and Aging*, *23*(1), 52–61. https://doi.org/10.1037/0882-7974.23.1.52

Uchino, B. N., Berg, C. A., Smith, T. W., Pearce, G., & Skinner, M. (2006). Age-related differences in ambulatory blood pressure during daily stress: Evidence for greater blood pressure reactivity with age. *Psychology and Aging*, *21*(2), 231–239. https://doi.org/10.1037/0882-7974.21.2.231

Wrzus, C., Luong, G., Wagner, G. G., & Riediger, M. (2015). Can't get it out of my head: Age differences in affective responsiveness vary with preoccupation and elapsed time after daily hassles. *Emotion*, *15*(2), 257–269. https://doi.org/10.1037/emo0000019

Wrzus, C., Müller, V., Wagner, G. G., Lindenberger, U., & Riediger, M. (2013). Affective and cardiovascular responding to unpleasant events from adolescence to old age: Complexity of events matters. *Developmental Psychology*, *49*(2), 384–397. https://doi.org/10.1037/a0028325

Yaribeygi, H., Panahi, Y., Sahraei, H., Johnston, T. P., & Sahebkar, A. (2017). The impact of stress on body function: A review. *EXCLI Journal*, *16*, 1057–1072. https://doi.org/10.17179/excli2017-480

Received March 22, 2022
Revision received July 18, 2022
Accepted August 12, 2022 ■