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Sleep Duration and Affective Reactivity to Stressors and Positive Events in Daily Life

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Objective: Experimental evidence suggests that inadequate sleep disrupts next-day affective processing and evokes greater stress reactivity. However, less research has focused on whether sleep predicts next-day affective reactivity to naturally occurring stressors and positive events in daily life, as well as the reversed direction of association (i.e., affective reactivity to daily events as predictors of subsequent sleep). The purpose of this study was to evaluate the within-person, bidirectional associations between nightly sleep duration and day-to-day fluctuations in affect related to stressors and positive events. ***Method:*** Adults ages 33–84 (N = 1,982, 57% female) in the U.S. National Study of Daily Experiences II reported sociodemographics and chronic conditions at baseline, then completed telephone interviews for 8 consecutive days about their sleep duration, daily stressors, positive events, and affect. ***Results:*** Prior-night sleep duration moderated the link between current-day events and positive affect, but not negative affect. Specifically, nights of shorter-than-usual sleep duration predicted more pronounced decreases in positive affect in response to daily stressors, as well as smaller increases in positive affect in response to daily positive events. Results for the reversed direction of association showed no evidence for affective reactivity to daily events as predictors of subsequent sleep duration. People with more chronic conditions were more reactive to positive events, particularly after nights of longer sleep. ***Conclusion:*** Affective reactivity to daily stressors and positive events vary based upon sleep duration, such that sleep loss may amplify loss of positive affect on days with stressors, as well as reduce positive affective responsiveness to positive events.

Keywords: sleep, stress, positive events, positive affect, daily diary

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Affective responses to situations in daily life (e.g., interpersonal conflict, work demands) have implications for the development of stress-related mental and physical health conditions (Almeida, 2005). People who show greater affective reactivity to daily stressors—as indicated by the magnitude of difference in affect on days when stressors occur versus on stressor-free days—exhibit more physiological dysregulation (Sin, Sloan, McKinley, & Almeida, 2016; Sin, Graham-Engeland, Ong, & Almeida, 2015) and increased prospective risks for affective disorders (Charles, Piazza, Mogle, Sliwinski, & Almeida, 2013), chronic diseases (Piazza, Charles, Sliwinski, Mogle, & Almeida, 2013), and mortality (Chiang, Turiano, Mroczek, & Miller, 2018; Mroczek et al., 2015), compared to those who are less reactive to daily stressors. Sleep is both an antecedent and a consequence of daily psychosocial ex-

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periences (Lee, Crain, McHale, Almeida, & Buxton, 2017; Sin et al., 2017) and may therefore play a role in the links between affective reactivity to daily events and downstream health outcomes. The purpose of the current study was to evaluate bidirectional associations of sleep duration with affective reactivity to daily stressors and positive events, in addition to examining the moderating role of chronic health conditions. Our data came from the largest daily diary study of health and well-being in the United States, the National Study of Daily Experiences, which included assessments of sleep duration. Below, we review experimental and observational studies linking stress and positive experiences with sleep duration as well as other measures of sleep (e.g., quality, efficiency, sleep onset latency).

Sleep and Next-Day Stress Reactivity

Compelling evidence from experimental studies demonstrates that sleep loss predicts heightened next-day physiological and affective reactivity to stressors (Meerlo, Sgoifo, & Suchecki, 2008). In particular, total sleep deprivation has been shown to amplify reactivity to negative stimuli or to acute laboratory-based stressors, including increases in negative emotions (Franzen, Siegle, & Buysse, 2008), systolic blood pressure (Franzen et al., 2011), cortisol (Minkel et al., 2014), and amygdala activity (Yoo, Gujar, Hu, Jolesz, & Walker, 2007). These findings are complemented by observations of naturalistic sleep and stress patterns in daily life. For example, among patients with chronic pain, those with poorer sleep quality exhibited relatively greater affective reactivity to daily stressors and pain (Hamilton, Catley, & Karlson, 2007). Studies of daily life in medical residents (Zohar, Tzischinsky, Epstein, & Lavie, 2005) and college students (Flueckiger, Lieb, Meyer, Witthauer, & Mata, 2016) suggest that longer-than-usual sleep duration or better-than-usual sleep quality, respectively, buffer against the association between stressors and affect. Yet despite a growing literature on sleep and daily affect (Konjarski, Murray, Lee, & Jackson, 2018), there are relatively few naturalistic ambulatory studies (and none using a large representative sample across adulthood) that evaluate the links between sleep and affective reactivity to daily positive events and stressors.

Stress Reactivity and Subsequent Sleep

Self-reports of daytime stressors (Lee et al., 2017; Morin, Rodrigue, & Ivers, 2003) and bedtime stress, worry, and perseverative cognition (Åkerstedt et al., 2012; Van Laethem, Beckers, van Hooff, Dijksterhuis, & Geurts, 2016) have been shown to predict poorer subsequent sleep, including lower subjective sleep quality and longer sleep onset latency. However, other daily diary studies have reported null results for links between stressors or affect during the day with same-night sleep measures (Bouwmans, Bos, Hoenders, Oldehinkel, & de Jonge, 2017; Sin et al., 2017). These mixed findings in the literature may be due, in part, to the conflation of stressor exposure with other aspects of stress, such as stress appraisals, reactivity, and coping. Indeed, stress appraisals and perceived lack of control over stressors were more strongly related to subsequent sleep quality than exposure to (i.e., number of) daily stressors per se (Morin et al., 2003). Thus, the current study aims to shed light on affective reactivity as a key component of the daily stress process that may be particularly detrimental for subsequent sleep duration.

Associations of Sleep With Positive Affect and Positive Events

Higher trait or aggregate positive affect is a protective factor for sleep (Ong, Kim, Young, & Steptoe, 2017), possibly because people with high positive affect are more likely to engage in better health behaviors including sleep practices (Sin, Moskowitz, & Whooley, 2015) and because positive psychological states may buffer against the associations between psychosocial risk factors and self-reported sleep problems (Steptoe, O'Donnell, Marmot, & Wardle, 2008). Independent of trait-like levels of positive affect, greater within-person fluctuations in positive affect are related to worse sleep outcomes. For example, day-to-day variability in positive affect was associated with shorter sleep duration and greater morning tiredness in older adults (Leger, Charles, & Fingerman, 2019). In addition, people who exhibited greater fluctuations in positive affect in response to daily events (either stressors or positive events) had, on average, worse actigraphy-assessed sleep quality and shorter sleep duration (Ong et al., 2013). To better understand why fluctuations in positive affect may be related to worse sleep (or vice versa), it is critical to examine contextual factors—such as stressors and positive events—that are likely to prompt increased or decreased positive affect in daily life.

Maintenance of positive affect in the face of daily stressors (i.e., lower positive affect reactivity to stressors) is associated with better health, including lower inflammation and reduced mortality risk (Mroczek et al., 2015; Sin, Graham-Engeland, Ong, et al., 2015). Sleep may be a resource that protects against loss of positive affect in the face of stressors. Following nights of higher sleep quality or longer sleep duration than their usual, undergraduates had smaller declines in positive affect on high-stress days (Flueckiger et al., 2016), and high school students showed more recovery of morning positive affect after high-stress days (Chue, Gunthert, Kim, Alfano, & Ruggiero, 2018). In support of the reversed direction of association (i.e., positive affect reactivity to daily stressors predicting subsequent sleep), state ratings of calm on days with elevated stress were associated with better same-night sleep efficiency among undergraduate students (Pressman, Jenkins, Kraft-Feil, Rasmussen, & Scheier, 2017). The current research extends from these three prior studies by evaluating the bidirectional relationships between sleep duration and positive affect reactivity to stressors among adults who hold a variety of social roles and daily responsibilities (e.g., parenting, employment, caregiving), thus enhancing the generalizability of the findings.

Despite a number of studies linking sleep with next-day positive affect (Konjarski et al., 2018), the day-to-day associations between sleep and daily positive events are not well-understood. Minor positive events in daily life—such as spending quality time with loved ones or enjoying nature—are reported more frequently than are stressors (Sin & Almeida, 2018), and these events typically produce upticks in positive affect when they occur (see Zautra, Affleck, Tennen, Reich, & Davis, 2005 for theoretical discussion of cross-domain effects; i.e., positive affective responses to stressors and negative affective responses to positive events). Although positive events may happen unexpectedly or outside of one's control, positive events are often sought after and involve some degree of active engagement (Zautra et al., 2005). Given the influence of sleep duration on cognitive-emotional states (Walker & van der Helm, 2009; Zohar et al., 2005), whether people seek out positive events and are emotionally responsive to them (i.e., generate more positive affect when these events occur) may vary as a function of sleep. Shorter sleep duration predicted reduced positive affect reactivity to goal-enhancing work events among medical residents (Zohar et al., 2005), and experimental sleep disruption led to reduced attention bias to positively valenced stimuli (Finan et al., 2017). Regarding the opposite direction of effects (i.e., daily positive events predicting subsequent sleep quality or duration), we previously found that positive events at home were related to better same-night sleep quality, whereas positive events at work predicted worse sleep quality among two samples of middle-aged employees (Sin et al., 2017). Because elevated positive affect can precede shorter sleep duration (Sin et al., 2017) and longer total wake time (Talbot et al., 2012), the facilitative versus disruptive effects of positive events on subsequent sleep duration may depend, at least in part, on the magnitude of positive affect reactivity to the event.

Moderating Role of Chronic Conditions

The links between sleep duration and affective reactivity to daily events may differ based on the presence of chronic health conditions. Both sleep duration and daily stress are associated with cardiometabolic, neuroendocrine, and inflammatory pathways underlying disease risk (e.g., Buxton et al., 2010; Sin et al., 2016; Sin, Graham-Engeland, Ong, et al., 2015; Stawski, Cichy, Piazza, & Almeida, 2013), as well as higher rates of chronic conditions (Buxton & Marcelli, 2010; Leger, Charles, & Almeida, 2018; Piazza et al., 2013). People with existing chronic conditions are more vulnerable to the effects of stress on health: Cancer survivors (Costanzo, Stawski, Ryff, Coe, & Almeida, 2012) and patients with cardiovascular disease (Kop et al., 2008) exhibit greater affective and physical stress reactivity compared to healthy controls. In addition, affective reactivity to daily stressors is associated with 20-year mortality risk only among participants with existing chronic conditions (Chiang et al., 2018). Furthermore, individuals with elevated health risk are susceptible to the effects of sleep on stress reactivity (Prather, Puterman, Epel, & Dhabhar, 2014), but no research has examined chronic conditions as a potential moderator of the relationships between sleep duration and affective responses to stressors and positive events in daily life.

The Current Study

The current study evaluated bidirectional, within-person associations of sleep duration with daily event-related fluctuations in affect. A national U.S. sample of 1,982 adults ages 33–84 reported their nightly sleep duration and daily events and affect in daily diary interviews across 8 days. We hypothesized that shorter sleep duration would exacerbate increases in negative affect and loss of positive affect in response to next-day stressors, as well as dampened positive affective responsiveness to positive events. However, due to a lack of previous research on negative affect responses to daily positive events, we did not have an a priori hypothesis regarding the association between sleep and next-day negative affect reactivity to positive events. For the reversed direction of association (i.e., affective reactivity to daily events as predictors of subsequent sleep duration), we hypothesized that heightened negative affect and loss of positive affect on days when stressors occurred (relative to levels of affect on stressor-free days) would be associated with shorter same-night sleep, and amplified positive affect reactivity to daily positive events would precede shorter sleep. We did not have a prediction regarding the link between negative affect reactivity to daily positive events and subsequent sleep, as this topic had not been examined in past research. Lastly, as a secondary analysis, we evaluated whether people with more chronic conditions showed greater affective reactivity to stressors following nights of shorter sleep than longer sleep. We had no hypotheses regarding the moderating effects of chronic conditions on sleep and positive events.

Method

Participants and Design

The current study uses data collected as part of the second wave of the National Study of Daily Experiences (NSDE 2), the daily diary substudy of the Midlife in the United States (MIDUS) 2 Study. The first wave of NSDE did not have measures of daily positive affect or daily positive events; therefore, we only used data from NSDE 2. Between 2004 and 2009, a national U.S. sample of 2,022 adults ages 33–84 years completed daily diary interviews by telephone for 8 consecutive evenings. The interviews were conducted by professional interviewers using computer-assisted telephone interview programming. Study data and documentation are publicly available at https://doi.org/10.3886/ICPSR26841.v2.

The sample size of 2,022 participants and 14,893 interview days with sleep data was reduced to 1,982 participants and 12,240 interview days because our analyses required lagged data from 2 consecutive interview days, and the last interview day was excluded from analyses because there were no assessments of sleep that night. The sample size varied slightly based on whether the analytic outcome was affect or sleep duration; the exact sample sizes are noted in the tables. On average, participants completed a mean of 7.49 (of 8) daily interviews ($SD = 0.98$).

All participants provided informed consent. Study procedures were approved by Institutional Review Boards at the University of Wisconsin, Madison, and The Pennsylvania State University. Procedures for secondary data analyses were approved by the Behavioral Research Ethics Board at the University of British Columbia.

Measures

Prior-night sleep duration. During telephone interviews on 8 consecutive evenings, participants reported their prior-night sleep duration in response to the following question: "Since this time yesterday, how much time did you spend sleeping, not including time you may have spent napping?" Sleep quality was not assessed in this study.

Daily stressors. Participants reported whether each of seven types of stressors had occurred in the past 24 hr: argument or disagreement, avoided an argument, stressor at work/school, stressor at home, discrimination, network stressor (i.e., stressor that happened to a close friend or family member), and any other stressor (Almeida, Wethington, & Kessler, 2002). A dummy-coded variable for Stressor Day (1 = *yes*, 0 = *no*) was used to indicate the occurrence of any stressor that day. At the between-person level, this dummy-coded variable was averaged across days to represent the percentage of days during which any stressors had occurred.

Daily positive events. During the nightly telephone interviews, participants were asked whether each of the following five positive events had occurred in the past 24 hr: positive social interaction, positive experience at work/school/volunteer position, positive experience at home, network positive event (i.e., positive event experienced by close friend or relative), and any other positive event (Sin, Graham-Engeland, & Almeida, 2015). A dummy-coded variable for Positive Event Day (1 = *yes*, 0 = *no*) was used to indicate the occurrence of any positive event that day. This variable was averaged across days for each participant to indicate the percent of days during which any positive event had occurred.

Daily affect. Daily affect was assessed using measures developed for the MIDUS study (Kessler et al., 2002; Mroczek & Kolarz, 1998). Using a 5-point scale ranging from 0 (*None of the Time*) to 4 (*All of the Time*), participants reported their frequency of negative and positive emotions. Negative affect was assessed with 14 items: restless or fidgety, nervous, worthless, so sad nothing could cheer you up, everything was an effort, hopeless, lonely, afraid, jittery, irritable, ashamed, upset, angry, and frustrated (within-person reliability = .77, between-person reliability = .97; Scott et al., 2018). Positive affect was assessed with 13 items: in good spirits, cheerful, extremely happy, calm and peaceful, satisfied, full of life, close to others, like you belong, enthusiastic, attentive, proud, active, and confident (within-person reliability = .86, between-person reliability = .99; Scott et al., 2018). The affect items were averaged to compute two subscales: daily negative affect and daily positive affect.

Chronic health conditions. As part of a questionnaire in the main MIDUS study, participants reported their health conditions from the past 12 months using a checklist of 30 possible health conditions (e.g., diabetes, hypertension, arthritis). Participants were also asked whether they ever had cancer or heart disease. Following previous research (Piazza et al., 2013), each chronic condition was grouped into one of 15 categories: cancer, cardiovascular and vascular conditions, autoimmune conditions, diabetes, neurological conditions, lung conditions, pain-related conditions, persistent skin trouble, thyroid disease, hay fever, digestive and gastrointestinal conditions, urinary/bladder problems, gallbladder trouble, foot trouble, and oral health conditions. We excluded three items for emotional disorders, drug or alcohol problems, and chronic sleep problems because of their overlap with affect and sleep. Due to the right-skewed nature of the data (median = 2 health conditions, range = 0–12), participants were then grouped based on whether they reported *none, one, two, three,* or *four or more* conditions (Leger et al., 2018). Sixty-five participants did not complete the questionnaire; thus, secondary analyses that examined the moderating role of chronic health conditions had a sample size of 1,917 participants. The number of health conditions was initially considered as a covariate in the primary analyses, but it did not change the pattern of results. We therefore opted not to include health conditions in the primary analyses so that we could maximize the sample size and keep the models parsimonious.

Covariates. Age, sex (male vs. female), race (White, Black, other/unknown race), education level (high school graduate or below, some college, or 4-year college graduate), and weekday (vs. weekend) were included as covariates due to prior evidence demonstrating their associations with sleep and/or affective reactivity to daily stressors (e.g., Almeida & Kessler, 1998; Charles, Piazza, Luong, & Almeida, 2009; Cichy, Stawski, & Almeida, 2012). To more stringently evaluate the direction of association, we controlled for the lagged outcome (i.e., outcome variable measured on the prior day) because, for example, prior-day affect could be associated with prior-night sleep and current-day events and affect. Analyses also controlled for person-means of daily stressors or positive events (i.e., the percentage of days on which these events had occurred), sleep duration (in models predicting affective reactivity), and affect (in models predicting sleep duration).

Data Analysis

Multilevel modeling was used to account for the nesting of days within persons. Unconditional models were first run to enable the calculation of intraclass correlation coefficients (between-person level variance/total variance). We then ran two-level models to evaluate: (a) sleep duration predicting subsequent positive affect and negative affect reactivity to daily events, and (b) the reversed direction of association, that is, positive affect and negative affect reactivity to daily events predicting subsequent sleep duration. Because daily stressors and positive events tended to co-occur on the same days, they were entered simultaneously in the models to better evaluate their unique associations. In models testing sleep duration as a predictor of next-day affective reactivity to daily events, interaction terms for Prior-Night Sleep Duration × Stressors and for Prior-Night Sleep Duration × Positive Events were included at Level 1 to evaluate whether prior-night sleep duration moderated the link between current-day events and affect. In models evaluating affective reactivity to daily events as predictors of subsequent sleep duration, interaction terms for Daily Affect (i.e., positive affect or negative affect) by Stressors and by Positive Events were included at Level 1. In secondary analyses, we evaluated the number of chronic conditions as a moderator of the association between sleep duration and affective reactivity to daily events using 3-way interaction terms (e.g., Chronic Conditions × Prior-Night Sleep Duration × Current-Day Stressors predicting positive and negative affect).

At Level 1, variables were centered at the person-means to allow parameter estimates to be interpreted as deviations from the participant's mean affect or sleep duration. At Level 2, variables were centered at the grand means to evaluate between-person effects. A random effect was included for Daily Stressors and Daily Positive Events at Level 2 to allow individuals to vary from one another in their event-related fluctuations in affect or sleep. However, the random effect for positive events was removed for some models due to nonconvergence (Hoffman & Stawski, 2009); these models are denoted in Table 3 in the text and in Table S1 and S2 in the online supplementary materials. Analyses were conducted using R Version 4.0.0 (lme4 and lmerTest packages for multilevel modeling).

Results

Descriptives and Correlations

Participant characteristics and descriptive statistics for daily diary variables are shown in Table 1. The sample of 1,982 participants was 43% male and 85% White, with an average age of 56 years and an average sleep duration of 7.15 hr. Table 2 presents intraclass correlation coefficients, as well as the between- and within-person correlations for sleep duration, daily events, and daily affect. The intraclass correlation coefficients indicate that 40% of the variation in sleep duration, 17% in stressors, 25% in positive events, 52% in negative affect, and 75% in positive affect were attributable to between-person differences. Between-person correlations show that people with longer mean sleep duration tended to have lower daily negative affect, higher positive affect, lower daily stressor exposure, and more frequent positive events. Within-persons, longer prior-night sleep duration was correlated with current-day lower negative affect, higher positive affect, lower likelihood of reporting a stressor, and marginally lower likelihood of reporting a positive event.

Sleep Duration Predicting Affective Reactivity to Next-Day Events

Table 3 displays results from multilevel models for sleep duration predicting negative and positive affect reactivity to stressors and positive events. The within-person (WP) main effect for daily stressors indicates that on days when stressors occurred, negative affect increased by 0.16 and positive affect decreased by 0.13. Longer prior-night sleep duration predicted lower current-day negative affect and higher positive affect. The Sleep Duration (WP) × Stressors (WP) interaction indicates that prior-night sleep duration predicted positive affect reactivity to stressors, but not negative affect reactivity to stressors. As shown in the left panel of Figure 1, there was a greater loss in positive affect on stressor days when an individual slept 1 hour less than their usual sleep duration (simple slope: Est. = −0.17, *SE* = 0.01, $p < .001$) compared to when they slept 1 hour more than usual (simple slope: Est. = −0.10, *SE* = 0.01, $p < .001$).

With regard to positive events, within-person daily positive events were associated with increases in positive affect but was not associated with negative affect (see Table 3). Sleep duration significantly predicted greater increases in positive affect (but not negative affect) in response to daily positive events. As depicted in the right panel of Figure 1, the association between positive event occurrence and same-day positive affect was more pronounced following nights when sleep duration was 1 hour longer than usual (simple slope: Est. = 0.11, *SE* = 0.01, $p < .001$) than when prior-night sleep duration was 1 hour shorter than usual (simple slope: Est. = 0.07, *SE* = 0.01, $p < .001$).

Affective Reactivity to Daily Events Predicting Subsequent Sleep Duration

Table 4 displays the results of multilevel models for affective reactivity to daily events as predictors of same-night sleep duration. There were no significant main effects for daily affect, stressors, or positive events on subsequent sleep duration. The within-person interactions for Daily Affect by Stressors or by Positive Events were not significant, indicating that neither negative nor positive affect reactivity to stressors or positive events predicted subsequent sleep duration.

Moderating Effects of Chronic Conditions

The online supplementary materials contain results of our secondary analysis on a subset of 1,917 participants, in which the number of self-reported chronic conditions was evaluated as a moderator of the association between sleep duration and affective reactivity to daily events. As shown in Table S1, chronic conditions predicted lower positive affect and higher negative affect (main effects), significantly moderated the association between daily positive events and same-day positive affect (interaction: Est. = 0.02, 95% CI [0.00, 0.03], $p = .01$), and marginally moderated the association between daily positive events and same-day negative affect (interaction: Est. = −0.01, 95% CI [−0.01, 0.00], $p = .08$). The simple slopes revealed that on days with higher-than-usual positive events, people with more chronic conditions (i.e., 1 *SD* of 1.41 above the mean of 1.97) showed greater increases in positive affect (simple slope: Est. = 0.12, *SE* = 0.01, $p < .001$) and greater decreases in negative affect (simple slope: Est. = −0.02, *SE* = 0.01, $p = .02$), compared to people with fewer chronic conditions (Figure S1 in the online supplemental materials).

The three-way interaction for Chronic Conditions × Sleep Duration (WP) × Positive Events (WP) was marginally signif-

Table 1
Participant Characteristics

Variable	Mean (*SD*) or *N* (%)
Sociodemographics and health conditions	
Age, years	56.31 (12.19)
Sex (Ref = Male)	849 (42.8%)
Race (Ref = White)	1,679 (84.7%)
Black	215 (10.8%)
Other/Unknown	88 (4.4%)
Education (Ref = HS graduate or below)	615 (31.0%)
Some college	607 (30.6%)
College graduate	760 (38.3%)
Number of chronic health conditions	
None	371 (19.4%)
One	432 (22.5%)
Two	396 (20.7%)
Three	321 (16.7%)
Four or more	397 (20.7%)
Daily diary variables	
Sleep duration, hours	7.15 (1.03)
Negative affect	0.20 (0.26)
Positive affect	2.74 (0.70)
Stressors	0.39 (0.26)
Positive events	0.70 (0.27)
Weekday (vs. weekend)	73% of days (11%)

Note. *N* = 1,982 participants, except *N* = 1,917 for data on chronic health conditions. Affect was rated on a scale ranging from 0 (*none of the time*) to 4 *(all of the time*) scale. Daily stressors and positive events were coded 0 = *No* and 1 = *Yes*. Prior-night sleep duration was reported in hours.

Table 2
Between-Person Correlations (Above Diagonal) and Within-Person Correlations (Below Diagonal) for Daily Events, Affect, and Sleep

Variable	Sleep duration	Negative affect	Positive affect	Stressors	Positive events
Sleep duration, hours	**0.40**	−0.10***	0.06**	−0.05*	0.05*
Negative affect	−0.08***	**0.52**	−0.53***	0.42***	−0.03
Positive affect	0.06***	−0.39***	**0.75**	−0.31***	0.12***
Stressors	−0.06***	0.32***	−0.16***	**0.17**	0.29***
Positive events	−0.02†	0.03**	0.08***	0.05***	**0.25**

Note. $N = 1{,}982$ participants. Between-person correlations are shown above the diagonal, and within-person correlations are shown below the diagonal. Diagonals (**bold**) show intraclass correlation coefficients (i.e., between-person level variance/total variance) for the variables. Affect was rated on a scale ranging from 0 (*none of the time*) to 4 *(all of the time)* scale. Daily stressors and positive events were coded 0 = *No* and 1 = *Yes*. Prior-night sleep duration was reported in hours.
† $p \leq .10$. * $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$.

icant, suggesting a trend in which chronic conditions moderated the link between sleep duration and next-day positive affective reactivity to positive events (Est. = 0.01, 95% CI [−0.00, 0.02]; $p = .09$; Table S1). Figure S2 in the online supplemental materials shows that among participants with more chronic conditions, there were larger increases in positive affect in response to positive events following nights of longer sleep than shorter sleep, whereas participants with fewer chronic conditions showed the same degree of positive affective reactivity regardless of their prior-night sleep duration.

Table S2 shows the results of multilevel models for chronic conditions as a moderator of the association between affective reactivity to daily events and subsequent sleep duration. The number of chronic conditions was not directly associated with sleep duration, nor did it interact with daily affect or daily events to predict sleep duration. There was a marginally significant interaction ($p = .08$) for Chronic Conditions × Current-Day Stressors × Current-Day Negative Affect, but none of the simple slopes were significantly different from zero.

Table 3
Sleep Duration Predicting Next-Day Affective Reactivity to Stressors and Positive Events

	Positive affect			Negative affect		
Parameter	Est.	95% CI	*p*	Est.	95% CI	*p*
Fixed effects						
Intercept	2.77	[2.71, 2.83]	<.001	0.19	[0.17, 0.21]	<.001
Age	0.01	[0.00, 0.01]	<.001	−0.00	[−0.00, 0.00]	.53
Sex (1 = Male)	−0.01	[−0.07, 0.05]	.78	−0.01	[−0.02, 0.01]	.59
Race (Ref = White)						
Black	0.08	[−0.02, 0.18]	.10	0.07	[0.04, 0.10]	<.001
Other/Unknown	−0.02	[−0.16, 0.12]	.76	−0.02	[−0.07, 0.02]	.35
Education (Ref = High school)						
Some college	0.00	[−0.07, 0.08]	.97	−0.03	[−0.06, −0.01]	.006
College graduate	−0.03	[−0.10, 0.05]	.46	−0.04	[−0.06, −0.01]	.002
Weekday (vs. weekend)	−0.04	[−0.05, −0.02]	<.001	0.02	[0.02, 0.03]	<.001
Prior-day affect	0.01	[−0.01, 0.03]	.30	0.02	[−0.00, 0.03]	.06
Daily stressors (BP)	−0.91	[−1.03, −0.78]	<.001	0.44	[0.40, 0.48]	<.001
Daily stressors (WP)	−0.13	[−0.15, −0.12]	<.001	0.16	[0.14, 0.17]	<.001
Daily positive events (BP)	0.55	[0.43, 0.67]	<.001	−0.11	[−0.14, −0.07]	<.001
Daily positive events (WP)	0.09	[0.07, 0.11]	<.001	−0.01	[−0.02, 0.00]	.17
Sleep duration (BP)	0.02	[−0.01, 0.05]	.16	−0.01	[−0.02, −0.00]	.05
Sleep duration (WP)	0.02	[0.01, 0.03]	<.001	−0.01	[−0.01, −0.01]	<.001
Sleep duration (WP) × Stressors (WP)	0.03	[0.01, 0.05]	<.001	0.00	[−0.01, 0.01]	.94
Sleep duration (WP) × Positive events (WP)	0.02	[0.00, 0.04]	.03	−0.00	[−0.01, 0.01]	.37
Random effects						
Residual variance	0.13	[0.13, 0.13]		0.03	[0.03, 0.04]	
Intercept variance	0.41	[0.38, 0.44]		0.04	[0.04, 0.05]	
Daily stressors variance	0.02	[0.01, 0.03]		0.02	[0.02, 0.03]	
Correlation for intercept, stressors	−0.10	[−0.25, 0.03]		0.57	[0.50, 0.64]	
Daily positive events variance[a]	0.03	[0.02, 0.04]		—		
Correlation for intercept, positive events[a]	−0.33	[−0.46, −0.21]		—		

Note. $N_{persons} = 1{,}980$, $N_{days} = 12{,}240$. BP = between-person; WP = within-person. *Prior-day affect* refers to the previous day's positive affect for the model of positive affect reactivity and the previous day's negative affect for the model of negative affect reactivity.
[a] To ensure model convergence, we did not estimate the random effect for the slope of the association between daily positive events and negative affect.

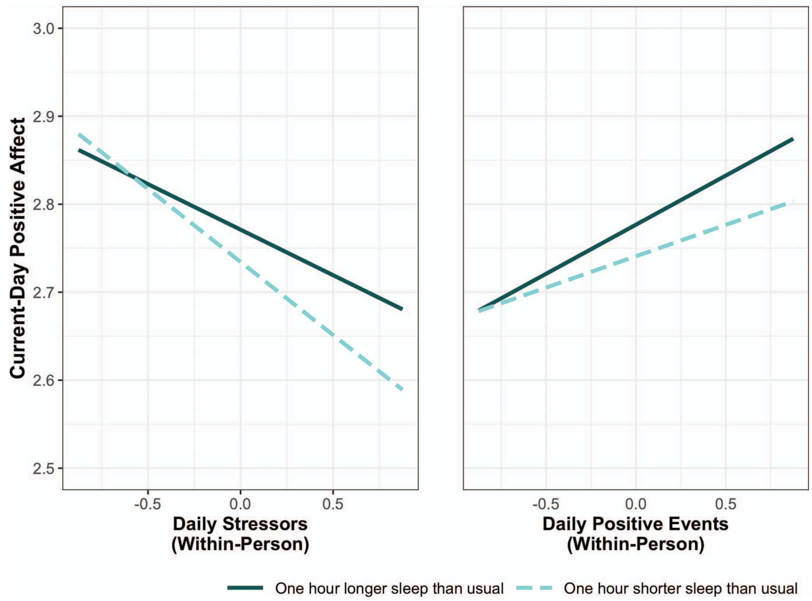

Figure 1. Prior-night sleep duration moderated the within-person link between daily events and affect. Longer-than-usual sleep duration was associated with smaller decreases in positive affect in response to daily stressors (left panel) and greater increases in positive affect in response to daily positive events (right panel), compared to affective reactivity to daily events following shorter-than-usual sleep duration. Daily stressors and positive events were centered on the person-means; the within-person *SD* was 0.41 for stressors and 0.37 for positive events. See the online article for the color version of this figure.

Discussion

The current study evaluated bidirectional, within-person associations between sleep duration and affective reactivity to daily stressors and positive events in a national U.S. sample of adults. Our hypotheses were partially supported, such that longer prior-night sleep duration buffered against declines in positive affect on days with stressors, in addition to enhancing positive affective responsiveness to daily positive events. Contrary to our expectations, however, sleep duration did not predict negative affect reactivity to next-day stressors, nor was affective reactivity to daily events associated with subsequent fluctuations in sleep duration. The degree of affective reactivity varied based on the presence of chronic conditions: Compared to people with fewer chronic conditions, those with more chronic conditions showed greater changes in affect in response to positive events, especially after nights of longer-than-usual sleep. These findings underscore the value of considering both positive events and stressors, as well as both positive and negative affect, when disentangling the links between sleep duration and daily experiences.

Our results suggest that sleep is particularly important for positively valenced experiences in daily life. Previous experimental studies have shown that sleep deprivation disrupted the positive affect system to a greater extent than the negative affect system (Finan et al., 2017; Pilcher, Callan, & Posey, 2015). Yet, results observed in experimental sleep restriction studies may differ from patterns of sleep and affective experiences in daily life because people may naturally compensate for sleep loss by reducing activities and avoiding stressful situations. Our study is among the first to show that prior lab-based findings about the impact of sleep on positive affect responses can transfer to ecological contexts. To our knowledge, Zohar and colleagues (2005) have conducted the only previous study of within-person relationships between naturalistic sleep loss and affective responses to both daily positive and negative events. In a sample of medical residents, sleep loss was related to dampened positive affect responses to goal-enhancing events, as well as intensified negative affect in response to goal-disruptive events (Zohar et al., 2005). The results from both their study and our current investigation support the notion that adequate sleep enhances cognitive-energy resources, therefore enabling individuals to more fully seek out, engage in, and derive benefits from positive situations (Zohar et al., 2005).

Our finding that sleep duration predicted positive affect (but not negative affect) reactivity to next-day stressors raises interesting possibilities that could be explored in future work. Although it is well-established that sleep loss is related to reduced ability to regulate emotions, the literature on sleep and emotions is not clear in pinpointing the pathways linking sleep and emotion regulation (Palmer & Alfano, 2017). Our study provides some distinction between situation selection versus other aspects of emotion regulation (e.g., appraisals, responses). In particular, consistent with other research (Sin et al., 2017), we saw that shorter-than-usual sleep duration was correlated with a greater likelihood of reporting stressors on the following day. This perhaps suggests that participants in this sample were generally not engaging in safety behaviors that would reduce stressor exposure (e.g., cutting back on activities, taking an easier day) that are more typically observed among people with insomnia (Harvey, 2002), or at the very least, our participants were not effective at reducing stressor exposure following shorter sleep. Regardless of situation selection, an individual's positive affect reactivity to daily stressors was relatively

Table 4
Affective Reactivity to Daily Stressors or Daily Positive Events Predicting Subsequent Sleep Duration

Parameter	PA reactivity predicting sleep duration			NA reactivity predicting sleep duration		
	Est.	95% CI	*p*	Est.	95% CI	*p*
Fixed effects						
Intercept	7.17	[7.07, 7.27]	<.001	7.18	[7.08, 7.27]	<.001
Age	0.00	[−0.00, 0.01]	.16	0.00	[−0.00, 0.01]	.13
Sex (1 = Male)	−0.04	[−0.13, 0.05]	.42	−0.04	[−0.13, 0.05]	.38
Race (Ref = White)						
Black	−0.47	[−0.62, −0.33]	<.001	−0.46	[−0.61, −0.31]	<.001
Other/Unknown	−0.22	[−0.43, −0.01]	.04	−0.22	[−0.43, −0.01]	.04
Education (Ref = High school)						
Some college	0.11	[−0.00, 0.23]	.05	0.11	[−0.01, 0.22]	.07
College graduate	0.21	[0.09, 0.32]	<.001	0.20	[0.08, 0.31]	.001
Weekday (vs. weekend)	−0.12	[−0.16, −0.07]	<.001	−0.12	[−0.16, −0.07]	<.001
Prior-night sleep duration	−0.07	[−0.09, −0.05]	<.001	−0.07	[−0.09, −0.05]	<.001
Daily stressors (BP)	−0.27	[−0.47 −0.07]	.007	−0.24	[−0.45, −0.03]	.02
Daily stressors (WP)	−0.01	[−0.06, 0.05]	.83	−0.01	[−0.06, 0.05]	.77
Daily positive events (BP)	0.10	[−0.08, 0.27]	.30	0.10	[−0.07, 0.28]	.25
Daily positive events (WP)	0.03	[−0.03, 0.09]	.39	0.02	[−0.04, 0.08]	.54
Daily affect (BP)	0.05	[−0.01, 0.12]	.12	−0.17	[−0.37, 0.03]	.09
Daily affect (WP)	−0.05	[−0.10, 0.01]	.13	0.06	[−0.06, 0.17]	.33
Daily affect (WP) × Stressors (WP)	−0.01	[−0.16, 0.13]	.85	−0.05	[−0.30, 0.21]	.72
Daily affect (WP) × Positive events (WP)	0.09	[−0.07, 0.25]	.28	0.16	[−0.12, 0.43]	.27
Random effects						
Residual variance	1.24	[1.20, 1.27]		1.24	[1.20, 1.28]	
Intercept variance	0.79	[0.72, 0.84]		0.79	[0.72, 0.84]	
Daily stressors variance	0.16	[0.08, 0.25]		0.16	[0.08, 0.25]	
Correlation for intercept, stressors	−0.25	[−0.40, −0.08]		−0.25	[−0.40, −0.08]	
Daily positive events variance	0.22	[0.13, 0.33]		0.21	[0.12, 0.33]	
Correlation for intercept, positive events	0.02	[−0.13, 0.16]		0.02	[−0.13, 0.16]	

Note. $N_{persons}$ = 1,982, N_{days} = 12,236. PA = positive affect; NA = negative affect; BP = between-person; WP = within-person. *Daily affect* refers to positive affect for the model of positive affect reactivity and negative affect for the model of negative affect reactivity.

more pronounced following nights of shorter sleep. We are unsure whether longer sleep duration led to reduced attention to the stressor, more favorable stress appraisals, or adaptive coping behaviors (e.g., seeking social support) following stressor occurrence, thereby supporting the maintenance of positive affect in the face of stress. With regard to negative affect reactivity to stressors, however, the experience of negative affect may have been preserved due to its functions for ensuring survival (e.g., vigilance, fighting, withdrawal). Additional research would be needed to evaluate mechanistic pathways such as changes in stress appraisals and coping.

Contrary to our hypotheses, affective reactivity to daily stressors and to positive events did not predict subsequent sleep duration. Some past studies have found evidence for bidirectional or cyclical relationships between nightly sleep and daily psychosocial experiences (Lee et al., 2017; Yap, Slavish, Taylor, Bei, & Wiley, 2020), whereas other studies indicate that sleep quality or duration were stronger determinants of next-day affect and experiences than vice versa (Sin et al., 2017; de Wild-Hartmann et al., 2013). It is possible that our measures were too coarse to capture the most detrimental aspects of stress. In particular, our daily diary questions asked about events that may have happened at any time during the day, rather than focusing specifically on events that continued to be particularly salient at bedtime. Other research has shown that evening stress (Yap et al., 2020) and presleep cognitive and somatic arousal (Morin et al., 2003; Winzeler et al., 2014) were associated with disrupted actigraphic and self-reported measures of sleep, suggesting that stress before bedtime may be especially harmful for subsequent sleep.

Importantly, the links between sleep and affective reactivity were not the same for everyone. Individuals with more chronic conditions appeared to garner greater affective benefits (i.e., increased positive affect and decreased negative affect) from positive events, and a marginally significant trend suggested that these benefits were more pronounced on days after longer sleep duration. Our results diverged from previous evidence that chronic conditions predicted heightened affective and inflammatory responses to stressors (Costanzo et al., 2012; Kop et al., 2008), possibly because we examined the number of chronic conditions—as an indication of cumulative health burden—rather than focusing on specific diseases. Future research on this topic should consider health conditions (such as chronic pain) for which sleep plays a particularly influential role in daily physical symptoms and well-being (Hamilton et al., 2007). In addition, although our results might suggest that sleep is an avenue by which people with chronic conditions can enhance their positive experiences, more work is needed to understand whether greater affective responsiveness to positive events is a sign of better psychological well-being or of vulnerabilities in emotion regulation (Ong et al., 2013).

The findings of this study should be carefully considered in light of its limitations. First, our sole measure of sleep was self-reported sleep duration. Self-report measures are susceptible to recall or reporting biases, and they tap into different aspects of sleep than inferred or objective measures (McCrae et al., 2008; Slavish et al., 2020). Unfortunately, we were unable to examine other indicators of sleep or daytime interference that are likely to be antecedents or consequences of affective reactivity to daily events. Second, prior-night sleep duration and daily experiences were assessed in the same evening telephone interviews. The reports of both sleep and daily experiences may have been influenced by common factors (e.g., mood and tiredness during the interview), therefore making the relationship between prior-night sleep and current-day experiences appear stronger than the relationship between variables assessed in separate interviews (i.e., the associations of daily affect and events with subsequent sleep duration). Third, our end-of-day assessments of daily affect and events do not allow us to disentangle whether event-related fluctuations in daily affect were truly reflective of affective reactivity or whether they indicated more affective lingering (i.e., slower recovery) following stressors and positive events. More frequent, in-depth measures of daily experiences will allow researchers to examine the time-course of affective reactivity versus recovery to daily events and to evaluate mechanisms (e.g., appraisals, cognitive interference, somatic arousal, coping; Smyth et al., 2018). Furthermore, our study did not examine event severity and intensity or possible differential effects based on specific types of events (e.g., work vs. home events; Sin et al., 2017). Nonetheless, our study is strengthened by its rich daily diary data of sleep and daily experiences from a large national sample of adults across a wide age range and with a variety of life experiences. MIDUS contains extensive health measures, thereby enabling these data to be linked to longitudinal health outcomes in future investigations. Furthermore, our research extends existing work on sleep and affective reactivity due to our evaluation of naturalistic positive events in daily life, which have been largely overlooked in the sleep literature.

In summary, this study evaluated hypothesized bidirectional relationships between self-reported sleep duration and affective reactivity to daily positive events and stressors, in addition to the moderating role of chronic conditions. In a national U.S. sample of midlife and older adults, sleep duration predicted greater fluctuations in positive affect (but not negative affect) in response to daily stressors and positive events, whereas affective reactivity to daily events was not predictive of subsequent sleep duration. These results indicate that fluctuations in sleep may be more consequential for positive affective responsiveness in daily life, whereas negative affective responsiveness was preserved regardless of longer- versus shorter-than-usual sleep duration. People with more chronic conditions appeared to derive more affective benefits from positive events following nights of longer-than-usual sleep. Given growing evidence that sleep has wide-ranging impacts on stress and well-being, our findings highlight the important role of sleep for influencing positive affect responses to naturally occurring events. Future research could examine whether efforts to promote sufficient sleep may lead to better maintenance of positive affect during stress and greater affective responsiveness to positive events in daily life.

References

Åkerstedt, T., Orsini, N., Petersen, H., Axelsson, J., Lekander, M., & Kecklund, G. (2012). Predicting sleep quality from stress and prior sleep—A study of day-to-day covariation across six weeks. *Sleep Medicine, 13,* 674–679. http://dx.doi.org/10.1016/j.sleep.2011.12.013

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

Almeida, D. M., & Kessler, R. C. (1998). Everyday stressors and gender differences in daily distress. *Journal of Personality and Social Psychology, 75,* 670–680. http://dx.doi.org/10.1037/0022-3514.75.3.670

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,* 41–55. http://dx.doi.org/10.1177/1073191102091006

Bouwmans, M. E. J., Bos, E. H., Hoenders, H. J. R., Oldehinkel, A. J., & de Jonge, P. (2017). Sleep quality predicts positive and negative affect but not vice versa. An electronic diary study in depressed and healthy individuals. *Journal of Affective Disorders, 207,* 260–267. http://dx.doi.org/10.1016/j.jad.2016.09.046

Buxton, O. M., & Marcelli, E. (2010). Short and long sleep are positively associated with obesity, diabetes, hypertension, and cardiovascular disease among adults in the United States. *Social Science & Medicine, 71,* 1027–1036. http://dx.doi.org/10.1016/j.socscimed.2010.05.041

Buxton, O. M., Pavlova, M., Reid, E. W., Wang, W., Simonson, D. C., & Adler, G. K. (2010). Sleep restriction for 1 week reduces insulin sensitivity in healthy men. *Diabetes, 59,* 2126–2133. http://dx.doi.org/10.2337/db09-0699

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,* 645–653. http://dx.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,* 733–741. http://dx.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,* 170–178. http://dx.doi.org/10.1037/hea0000567

Chue, A. E., Gunthert, K. C., Kim, R. W., Alfano, C. A., & Ruggiero, A. R. (2018). The role of sleep in adolescents' daily stress recovery: Negative affect spillover and positive affect bounce-back effects. *Journal of Adolescence, 66,* 101–111. http://dx.doi.org/10.1016/j.adolescence.2018.05.006

Cichy, K. E., Stawski, R. S., & Almeida, D. M. (2012). Racial differences in exposure and reactivity to daily family stressors. *Journal of Marriage and Family, 74,* 572–586. http://dx.doi.org/10.1111/j.1741-3737.2012.00971.x

Costanzo, E. S., Stawski, R. S., Ryff, C. D., Coe, C. L., & Almeida, D. M. (2012). Cancer survivors' responses to daily stressors: Implications for quality of life. *Health Psychology, 31,* 360–370. http://dx.doi.org/10.1037/a0027018

de Wild-Hartmann, J. A., Wichers, M., van Bemmel, A. L., Derom, C., Thiery, E., Jacobs, N., . . . Simons, C. J. P. (2013). Day-to-day associations between subjective sleep and affect in regard to future depression in a female population-based sample. *The British Journal of Psychiatry, 202,* 407–412. http://dx.doi.org/10.1192/bjp.bp.112.123794

Finan, P. H., Quartana, P. J., Remeniuk, B., Garland, E. L., Rhudy, J. L., Hand, M., . . . Smith, M. T. (2017). Partial sleep deprivation attenuates the positive affective system: Effects across multiple measurement modalities. *Sleep, 40*(1), zsw017. http://dx.doi.org/10.1093/sleep/zsw017

Flueckiger, L., Lieb, R., Meyer, A. H., Witthauer, C., & Mata, J. (2016). The importance of physical activity and sleep for affect on stressful days: Two intensive longitudinal studies. *Emotion, 16,* 488–497. http://dx.doi.org/10.1037/emo0000143

Franzen, P. L., Gianaros, P. J., Marsland, A. L., Hall, M. H., Siegle, G. J., Dahl, R. E., & Buysse, D. J. (2011). Cardiovascular reactivity to acute psychological stress following sleep deprivation. *Psychosomatic Medicine, 73,* 679–682. http://dx.doi.org/10.1097/PSY.0b013e31822ff440

Franzen, P. L., Siegle, G. J., & Buysse, D. J. (2008). Relationships between affect, vigilance, and sleepiness following sleep deprivation. *Journal of Sleep Research, 17,* 34–41. http://dx.doi.org/10.1111/j.1365-2869.2008.00635.x

Hamilton, N. A., Catley, D., & Karlson, C. (2007). Sleep and the affective response to stress and pain. *Health Psychology, 26,* 288–295. http://dx.doi.org/10.1037/0278-6133.26.3.288

Harvey, A. G. (2002). Identifying safety behaviors in insomnia. *Journal of Nervous and Mental Disease, 190,* 16–21. http://dx.doi.org/10.1097/00005053-200201000-00004

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

Kessler, R. C., Andrews, G., Colpe, L. J., Hiripi, E., Mroczek, D. K., Normand, S. L. T., . . . Zaslavsky, A. M. (2002). Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychological Medicine, 32,* 959–976. http://dx.doi.org/10.1017/S0033291702006074

Konjarski, M., Murray, G., Lee, V. V., & Jackson, M. L. (2018). Reciprocal relationships between daily sleep and mood: A systematic review of naturalistic prospective studies. *Sleep Medicine Reviews, 42,* 47–58. http://dx.doi.org/10.1016/j.smrv.2018.05.005

Kop, W. J., Weissman, N. J., Zhu, J., Bonsall, R. W., Doyle, M., Stretch, M. R., . . . Tracy, R. P. (2008). Effects of acute mental stress and exercise on inflammatory markers in patients with coronary artery disease and healthy controls. *The American Journal of Cardiology, 101,* 767–773. http://dx.doi.org/10.1016/j.amjcard.2007.11.006

Lee, S., Crain, T. L., McHale, S. M., Almeida, D. M., & Buxton, O. M. (2017). Daily antecedents and consequences of nightly sleep. *Journal of Sleep Research, 26,* 498–509. http://dx.doi.org/10.1111/jsr.12488

Leger, K. A., Charles, S. T., & Almeida, D. M. (2018). Let it go: Lingering negative affect in response to daily stressors is associated with physical health years later. *Psychological Science, 29,* 1283–1290. http://dx.doi.org/10.1177/0956797618763097

Leger, K. A., Charles, S. T., & Fingerman, K. L. (2019). Affect variability and sleep: Emotional ups and downs are related to a poorer night's rest. *Journal of Psychosomatic Research, 124,* 109758. http://dx.doi.org/10.1016/j.jpsychores.2019.109758

McCrae, C. S., McNamara, J. P. H., Rowe, M. A., Dzierzewski, J. M., Dirk, J., Marsiske, M., & Craggs, J. G. (2008). Sleep and affect in older adults: Using multilevel modeling to examine daily associations. *Journal of Sleep Research, 17,* 42–53. http://dx.doi.org/10.1111/j.1365-2869.2008.00621.x

Meerlo, P., Sgoifo, A., & Suchecki, D. (2008). Restricted and disrupted sleep: Effects on autonomic function, neuroendocrine stress systems and stress responsivity. *Sleep Medicine Reviews, 12,* 197–210. http://dx.doi.org/10.1016/j.smrv.2007.07.007

Minkel, J., Moreta, M., Muto, J., Htaik, O., Jones, C., Basner, M., & Dinges, D. (2014). Sleep deprivation potentiates HPA axis stress reactivity in healthy adults. *Health Psychology, 33,* 1430–1434. http://dx.doi.org/10.1037/a0034219

Morin, C. M., Rodrigue, S., & Ivers, H. (2003). Role of stress, arousal, and coping skills in primary insomnia. *Psychosomatic Medicine, 65,* 259–267. http://dx.doi.org/10.1097/01.PSY.0000030391.09558.A3

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,* 1333–1349. http://dx.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., III. (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,* 398–406. http://dx.doi.org/10.1093/geronb/gbt107

Ong, A. D., Exner-Cortens, D., Riffin, C., Steptoe, A., Zautra, A., & Almeida, D. M. (2013). Linking stable and dynamic features of positive affect to sleep. *Annals of Behavioral Medicine, 46,* 52–61. http://dx.doi.org/10.1007/s12160-013-9484-8

Ong, A. D., Kim, S., Young, S., & Steptoe, A. (2017). Positive affect and sleep: A systematic review. *Sleep Medicine Reviews, 35,* 21–32. http://dx.doi.org/10.1016/j.smrv.2016.07.006

Palmer, C. A., & Alfano, C. A. (2017). Sleep and emotion regulation: An organizing, integrative review. *Sleep Medicine Reviews, 31,* 6–16. http://dx.doi.org/10.1016/j.smrv.2015.12.006

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,* 110–120. http://dx.doi.org/10.1007/s12160-012-9423-0

Pilcher, J. J., Callan, C., & Posey, J. L. (2015). Sleep deprivation affects reactivity to positive but not negative stimuli. *Journal of Psychosomatic Research, 79,* 657–662. http://dx.doi.org/10.1016/j.jpsychores.2015.05.003

Prather, A. A., Puterman, E., Epel, E. S., & Dhabhar, F. S. (2014). Poor sleep quality potentiates stress-induced cytokine reactivity in postmenopausal women with high visceral abdominal adiposity. *Brain, Behavior, and Immunity, 35,* 155–162. http://dx.doi.org/10.1016/j.bbi.2013.09.010

Pressman, S. D., Jenkins, B. N., Kraft-Feil, T. L., Rasmussen, H., & Scheier, M. F. (2017). The whole is not the sum of its parts: Specific types of positive affect influence sleep differentially. *Emotion, 17,* 778–793. http://dx.doi.org/10.1037/emo0000256

Scott, S. B., Sliwinski, M. J., Zawadzki, M., Stawski, R. S., Kim, J., Marcusson-Clavertz, D., . . . Smyth, J. M. (2018). A coordinated analysis of variance in affect in daily life. *Assessment*. Advance online publication. http://dx.doi.org/10.1177/1073191118799460

Sin, N. L., & Almeida, D. M. (2018). Daily positive experiences and health: Biobehavioral pathways and resilience to daily stress. In C. D. Ryff & R. F. Krueger (Eds.), *The Oxford handbook of integrative health science* (pp. 155–172). New York, NY: Oxford University Press. http://dx.doi.org/10.1093/oxfordhb/9780190676384.013.10

Sin, N. L., Almeida, D. M., Crain, T. L., Kossek, E. E., Berkman, L. F., & Buxton, O. M. (2017). Bidirectional, temporal associations of sleep with positive events, affect, and stressors in daily life across a week. *Annals of Behavioral Medicine, 51,* 402–415. http://dx.doi.org/10.1007/s12160-016-9864-y

Sin, N. L., Graham-Engeland, J. E., & Almeida, D. M. (2015). Daily positive events and inflammation: Findings from the National Study of Daily Experiences. *Brain, Behavior, and Immunity, 43,* 130–138. http://dx.doi.org/10.1016/j.bbi.2014.07.015

Sin, N. L., Graham-Engeland, J. E., Ong, A. D., & Almeida, D. M. (2015). Affective reactivity to daily stressors is associated with elevated inflammation. *Health Psychology, 34,* 1154–1165. http://dx.doi.org/10.1037/hea0000240

Sin, N. L., Moskowitz, J. T., & Whooley, M. A. (2015). Positive affect and health behaviors across 5 years in patients with coronary heart disease: The Heart and Soul Study. *Psychosomatic Medicine, 77,* 1058–1066. http://dx.doi.org/10.1097/PSY.0000000000000238

Sin, N. L., Sloan, R. P., McKinley, P. S., & Almeida, D. M. (2016). Linking daily stress processes and laboratory-based heart rate variability in a national sample of midlife and older adults. *Psychosomatic Medicine, 78,* 573–582. http://dx.doi.org/10.1097/PSY.0000000000000306

Slavish, D. C., Asbee, J., Veeramachaneni, K., Messman, B. A., Scott, B., Sin, N. L., . . . Dietch, J. R. (2020). The cycle of daily stress and sleep: Sleep measurement matters. *Annals of Behavioral Medicine*. Advance online publication. http://dx.doi.org/10.1093/abm/kaaa053

Smyth, J. M., Sliwinski, M. J., Zawadzki, M. J., Scott, S. B., Conroy, D. E., Lanza, S. T., . . . Almeida, D. M. (2018). Everyday stress response targets in the science of behavior change. *Behaviour Research and Therapy, 101,* 20–29. http://dx.doi.org/10.1016/j.brat.2017.09.009

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,* 2654–2665. http://dx.doi.org/10.1016/j.psyneuen.2013.06.023

Steptoe, A., O'Donnell, K., Marmot, M., & Wardle, J. (2008). Positive affect, psychological well-being, and good sleep. *Journal of Psychosomatic Research, 64,* 409–415. http://dx.doi.org/10.1016/j.jpsychores.2007.11.008

Talbot, L. S., Stone, S., Gruber, J., Hairston, I. S., Eidelman, P., & Harvey, A. G. (2012). A test of the bidirectional association between sleep and mood in bipolar disorder and insomnia. *Journal of Abnormal Psychology, 121,* 39–50. http://dx.doi.org/10.1037/a0024946

Van Laethem, M., Beckers, D. G., van Hooff, M. L., Dijksterhuis, A., & Geurts, S. A. (2016). Day-to-day relations between stress and sleep and the mediating role of perseverative cognition. *Sleep Medicine, 24,* 71–79. http://dx.doi.org/10.1016/j.sleep.2016.06.020

Walker, M. P., & van der Helm, E. (2009). Overnight therapy? The role of sleep in emotional brain processing. *Psychological Bulletin, 135,* 731–748. http://dx.doi.org/10.1037/a0016570

Winzeler, K., Voellmin, A., Schäfer, V., Meyer, A. H., Cajochen, C., Wilhelm, F. H., & Bader, K. (2014). Daily stress, presleep arousal, and sleep in healthy young women: A daily life computerized sleep diary and actigraphy study. *Sleep Medicine, 15,* 359–366. http://dx.doi.org/10.1016/j.sleep.2013.09.027

Yap, Y., Slavish, D. C., Taylor, D. J., Bei, B., & Wiley, J. F. (2020). Bi-directional relations between stress and self-reported and actigraphy-assessed sleep: A daily intensive longitudinal study. *Sleep, 43*(3), zsz250. http://dx.doi.org/10.1093/sleep/zsz250

Yoo, S.-S., Gujar, N., Hu, P., Jolesz, F. A., & Walker, M. P. (2007). The human emotional brain without sleep—A prefrontal amygdala disconnect. *Current Biology, 17*(20), R877–R878. http://dx.doi.org/10.1016/j.cub.2007.08.007

Zautra, A. J., Affleck, G. G., Tennen, H., Reich, J. W., & Davis, M. C. (2005). Dynamic approaches to emotions and stress in everyday life: Bolger and Zuckerman reloaded with positive as well as negative affects. *Journal of Personality, 73,* 1511–1538. http://dx.doi.org/10.1111/j.0022-3506.2005.00357.x

Zohar, D., Tzischinsky, O., Epstein, R., & Lavie, P. (2005). The effects of sleep loss on medical residents' emotional reactions to work events: A cognitive-energy model. *Sleep, 28,* 47–54. http://dx.doi.org/10.1093/sleep/28.1.47

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