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Daily Stress Processes in a Pandemic: The Effects of Worry, Age, and Affect

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Abstract

Background and Objectives: In March 2020, the World Health Organization declared the coronavirus disease 2019 (COVID-19) a pandemic. Given that such a global event might affect day-to-day stress processes, the current study examined individuals' daily stress reactivity and its moderators early in the COVID-19 pandemic.
Research Design and Methods: Two-level, multilevel models examined the daily relationship between perceived stress and negative affect, or stress reactivity, as well as the moderating effects of daily pandemic worry, age, and daily positive affect on this process. Participants included 349 individuals (age range = 26–89) from the Notre Dame Study of Health & Well-being who completed a 28-day, daily diary study at the beginning of the COVID-19 pandemic.
Results: Older individuals were less stress-reactive than younger individuals. Within individuals, however, stress reactivity was buffered by daily positive affect and exacerbated by daily pandemic worry. Finally, although daily positive affect buffered daily stress reactivity, this effect was weaker on days individuals were more worried about the COVID-19 pandemic.
Discussion and Implications: The mobilization of positive emotion may be a promising avenue for buffering stress reactivity during the COVID-19 pandemic, although this may be limited on days individuals are particularly concerned about the pandemic.

Keywords: Coronavirus, COVID-19, Emotions, Hierarchical linear modeling

On March 11, 2020, the World Health Organization declared the coronavirus disease 2019 (COVID-19) a pandemic. In a matter of weeks, 95% of the U.S. population was under statewide stay-at-home orders that necessitated numerous lifestyle changes (Mervosh et al., 2020). Although individuals experience a myriad of stressors under typical circumstances, contextual factors like the COVID-19 pandemic may drive individuals to appraise typically innocuous events as threatening or harmful (Almeida, 2005; Folkman, 2008). Indeed, grappling with chronic stressors like the COVID-19 pandemic may deplete individuals' coping resources, ultimately increasing their *stress reactivity*, or immediate negative emotional responses to stress.

Considering the COVID-19 pandemic is ongoing, and daily stress reactivity predicts long-term health and well-being (Charles et al., 2013; Piazza et al., 2013), it is paramount to identify risk and protective factors for stress reactivity amidst the pandemic. Although the COVID-19 pandemic profoundly disrupted the daily routines of individuals from all walks of life, there were notable individual differences in pandemic worry (Barber & Kim, 2020). Such differences may not only affect stress reactivity during this time but also its potential moderators. Specifically, although age (Blaxton et al., 2020; Scott et al., 2013) and positive affect (Folkman, 2008; Leger et al., 2020; Ong et al., 2006) influence stress reactivity under

typical circumstances, it is unknown how these factors might affect stress reactivity during a pandemic. Therefore, the current study examined the moderating effects of daily pandemic worry, age, and daily positive affect on daily stress reactivity immediately following the enactment of stay-at-home orders intended to slow the spread of the COVID-19 pandemic.

Contextualizing Stress Reactivity: Chronic Stress and Pandemic Worry

Contextual factors like chronic stress shape individuals' daily stress processes (Almeida, 2005; Serido et al., 2004; Sliwinski et al., 2009; Stawski et al., 2008). Indeed, individuals with higher global perceptions of life stress tend to experience more stressors than those with lower global perceptions of life stress (Stawksi et al., 2008). Beyond higher stress exposure, however, individuals with higher global perceptions of life stress also tend to experience higher daily stress reactivity (Blaxton et al., 2020; Scott et al., 2013; Stawski et al., 2008), as evidenced by stronger daily relationships between stress and negative affect. Relatedly, individuals with higher chronic home stress also experience higher reactivity to daily work and home stressors, indicating the possibility for chronic stress in one aspect of life to affect one's ability to cope with stressors in other aspects of life (Serido et al., 2004). Finally, the contextualizing effects of global perceived stress even operate within individuals, as Sliwinski et al. (2009) noted that *when* individuals had higher global perceptions of stress, they also displayed heightened daily stress reactivity. In this way, the presence of chronic stress contextualizes daily stress processing, driving heightened reactivity to stressors both between and within individuals.

Therefore, the COVID-19 pandemic, a novel chronic stressor experienced by all, shaped individuals' daily stress processes. Indeed, most individuals found emergency directives such as statewide stay-at-home orders during the COVID-19 pandemic stressful (Park et al., 2020; Whitehead & Torossian, 2020). Under these directives, masks had to be worn in public spaces, gatherings with family and friends were canceled, and nonessential businesses were closed across the nation. In this way, key sources of social support, and thus, coping resources, were limited (Almeida, 2005; Folkman, 2008). Additionally, such emergency directives were continually updated in response to groundbreaking research on COVID-19, driving further uncertainty regarding the pandemic's length and long-term consequences, and thus, stress (Whitehead & Torossian, 2020). Despite the universal experience of the COVID-19 pandemic and its associated restrictions, however, there were individual differences in pandemic worry (Barber & Kim, 2020), as well as expectations for the pandemic's length and consequences (i.e., monetary, "normal life"; Whitehead, 2020). This had implications for behavioral changes (Barber & Kim, 2020), as well as perceived stress and negative affect (Whitehead, 2020). Taken together, despite universal experience, the COVID-19 pandemic did not uniformly influence day-to-day routines and stress processes (Barber & Kim, 2020; Whitehead, 2020). Rather, those who were more worried about the pandemic or expected the pandemic to have long-term effects on daily life were most affected.

Stress Reactivity, Age, and Pandemic Worry

In addition to chronic life stressors such as the COVID-19 pandemic, there is evidence for age-related differences and change in daily stress reactivity (Almeida, 2005; Blaxton et al., 2020; Mroczek & Almeida, 2004; Scott et al., 2013; Sliwinski et al., 2009). Extant findings regarding these age effects, however, are mixed. Mroczek and Almeida (2004) found that older individuals experienced higher stress reactivity than younger individuals, although the opposite effect was found in two other studies (Blaxton et al., 2020; Scott et al., 2013). Similarly, although Sliwinski et al. (2009) found that stress reactivity increased over time, Blaxton et al. (2020) found that stress reactivity decreased over time. Thus, there is consistent evidence for age-related differences and change in stress reactivity across studies, but findings are discrepant in terms of whether older age and/or the aging process buffers (Blaxton et al., 2020; Scott et al., 2013) or exacerbates (Mroczek et al., 2004; Sliwinski et al., 2009) stress reactivity.

Age effects on stress reactivity, however, cannot be separated from the context in which they are experienced, and this includes chronic stressors like the COVID-19 pandemic (Almeida, 2005). There were notable age differences in risk perception regarding several aspects of the COVID-19 pandemic (Bruine de Bruin, 2020). Indeed, compared to younger individuals, older individuals perceived a higher risk of dying if they were to be infected by COVID-19, although they also perceived lower risks of contracting COVID-19, losing their jobs, running out of money, and quarantining (Bruine de Bruin, 2020). Additionally, during the COVID-19 pandemic, younger adults tended to be more reactive to non–COVID-19-related stressors than older adults, although reactivity to COVID-19-related stressors was similar across age groups (Klaiber et al., 2020). Given that pandemic worry was associated with behavioral change (Barber & Kim, 2020), perhaps higher risk perception about the pandemic among younger adults (Bruine de Bruin, 2020) was associated with more behavioral changes (Barber & Kim, 2020), which, in turn, may have depleted coping resources (Almeida, 2005; Folkman, 2008), ultimately driving higher daily stress reactivity among younger adults (Klaiber et al., 2020). The current study tested whether daily pandemic worry and/or age moderated stress reactivity amidst the COVID-19 pandemic.

Stress Reactivity, Positive Affect, and Pandemic Worry

Scholars have also long recognized the role of positive emotions in the stress and coping process (Folkman, 2008; Leger et al., 2020; Ong et al., 2006). Specifically, after individuals experience negative emotion in response to stress, they often engage in meaning-focused coping (Folkman, 2008). *Meaning-focused coping*, which entails reappraising a threatening or harmful (i.e., negative) situation as challenging (i.e., potentially positive) by finding or reminding oneself of a "bright-side," changing or reprioritizing one's goals, and/or searching for positive meaning in ordinary events, mobilizes positive affect. This stressor-related mobilization of positive affect temporarily relieves negative affect, which replenishes and sustains coping resources. Put differently, positive affect leads individuals to reappraise stressors as challenges instead of threats or harms and ultimately resolve them. Therefore, positive affect may help individuals cope with daily stressors, and thus decrease stress reactivity.

Extant research indicates that positive affect, indeed, buffers daily stress reactivity (Leger et al., 2020; Ong et al., 2006). Individuals generally experience higher levels of negative affect on days they experience either at least one stressor (Leger et al., 2020) or higher appraised stress severity (Ong et al., 2006). When individuals concurrently experience higher levels of positive affect, however, the daily, stress-related increase in negative affect is much weaker (Leger et al., 2020; Ong et al., 2006). Importantly, this buffering effect was apparent under both typical circumstances (Leger et al., 2020; Ong et al., 2006), as well as in the context of a common chronic stressor (bereavement; Ong et al., 2006). Given that positive affect buffers against stress reactivity, both in typical daily life and in the context of chronic stress (Leger et al., 2020; Ong et al., 2006), positive affect may serve as an important coping resource amidst the COVID-19 pandemic. It is unclear, however, as to whether this process operated differently in the context of the COVID-19 pandemic, especially with other potential moderators such as daily pandemic worry and age. Thus, the current study examined whether positive affect buffered individuals' daily stress reactivity amidst the initial stay-at-home orders of the COVID-19 pandemic, as well as whether this buffering effect was dependent on daily pandemic worry and age.

The Current Study

Although stress reactivity is a typical occurrence (Blaxton et al., 2020; Mroczek & Almeida, 2004; Ong et al., 2006; Sliwinski et al., 2009; Stawski et al., 2008), it is unclear how this process might operate during the COVID-19 pandemic, a chronic stressor that disrupted virtually all aspects of life (Park et al., 2020; Whitehead & Torossian, 2020). Indeed, because chronic stress exacerbates daily stress reactivity (Blaxton et al., 2020; Serido et al., 2004; Sliwinski et al., 2009; Stawski et al., 2008), individuals may be particularly vulnerable to daily stressors amidst navigating life in a pandemic. Furthermore, although stress reactivity typically depends on age and positive affect (Blaxton et al., 2020; Leger et al., 2020; Mroczek & Almeida, 2004; Ong et al., 2006; Scott et al., 2013), such effects may have depended on not only each other, but also the extent to which individuals were worried about the COVID-19 pandemic. To examine these effects on daily stress reactivity, we conducted a 28-day, daily diary burst study beginning 11 days after the stay-at-home order of the COVID-19 pandemic was enacted. Using two-level, multilevel modeling, we examined within-person and between-person effects of positive affect and pandemic worry, between-person effects of age, as well as their interactive effects, on daily stress reactivity.

We tested several hypotheses. First, given that positive emotion may serve as a coping resource against stress (Folkman, 2008), we hypothesized that daily positive affect would buffer daily perceived stress reactivity, as well as the daily relationship between pandemic worry and negative affect. Second, given that individuals were not uniformly stressed (Whitehead & Torossian, 2020), worried (Bruine de Bruin, 2020), or expectant about the pandemic's length and consequences, which may have implications for stress appraisal and negative affect (Whitehead, 2020), we hypothesized that daily pandemic worry would exacerbate individuals' daily stress reactivity. Third, because younger individuals were more concerned than older individuals about several consequences of the pandemic (Bruine de Bruin, 2020), and experienced higher reactivity to non–COVID-19-related stress than older individuals (Klaiber et al., 2020), we hypothesized that older individuals would be less stress-reactive than younger individuals. Fourth, given that pandemic worry was associated with behavioral changes regardless of age (Barber & Kim, 2020), and individuals of all ages experienced similar reactivity to COVID-19-related stress (Klaiber et al., 2020), we did not anticipate age differences in the relationship between daily pandemic worry and negative affect. Finally, given that individual differences in pandemic stress (Whitehead & Torossian, 2020), worry (Bruine de Bruin, 2020), and expectations (Whitehead, 2020) may deplete coping resources (Almeida, 2005), we hypothesized that daily positive affect's buffering effect on stress reactivity would be weaker on days individuals were more worried about the COVID-19 pandemic. Age differences in the within-person, two-way interaction effects were also examined. Due to the inconsistent prior findings regarding age effects on stress reactivity (Blaxton et al., 2020; Mroczek & Almeida, 2004), as well as the novelty of these moderating effects in the context of the COVID-19 pandemic, however, we do not offer hypotheses for these exploratory analyses on age effects.

Method

Participants

The current sample included 359 participants from the young, midlife, and later-life cohorts of the Notre Dame Study of Health & Well-being (NDHWB), a 10-year, longitudinal study of adult development and aging (Whitehead & Bergeman, 2014). The NDHWB sample comprised community-dwelling individuals from Northern Indiana. On March 24, 2020, Governor Eric Holcomb of Indiana enacted a statewide stay-at-home order. Immediately following this mandate, NDHWB staff members recruited participants by telephone to complete a 28-day, daily diary burst study regarding their stress and emotions during the pandemic. This daily diary burst began on April 4, 2020, 11 days after the stay-at-home order was enacted. Participants were instructed to complete a brief online survey that was sent to them via e-mail every evening for 28 days. They were gifted $10 for each week of participation and were told they would receive a $10 bonus for completion of the entire study. To limit participant burden, participants were reassured that they could skip a day if necessary. Notably, only 267 individuals participated the first day, as many survey links were mistakenly sent to junk or spam folders. Across the study period, however, an average of 297 individuals (*SD* = 10.99) participated each day. Data collection for this study underwent and received approval from the Notre Dame Institutional Review Board (protocol #19-09-5533). For inclusion in analyses, participants were required to have completed at least two daily surveys across the study period. On average, however, the 349 included participants completed approximately 24 daily diaries (*SD* = 6.34) across the 28-day study period. Furthermore, of the 9,772 total observations available, 8,226 observations were used in the primary analyses. Thus, 84% of possible observations were used.

As of the study's starting date, the current sample's age range spanned adulthood (range = 26–89), with an average age of 58.18 (*SD* = 14.47). The current sample identified as predominantly female (61.89%) and White/Caucasian (84.81%), with 8.88% identifying as Black/African American, 3.15% identifying as Hispanic, 0.86% identifying as Asian/Pacific Islander, 0.57% identifying as Native American, and 1.73% identifying as multiracial/unknown. Further demographic information was provided at Wave 1 of the NDHWB. Specifically, 99.58% of the sample graduated from high school, with 57.61% earning a college degree or higher. Finally, 14.23% earned less than $25,000 per year, 61.09% earned between $25,000 and $75,000 per year, and 24.69% earned more than $75,000 per year.

Measures

Daily positive and negative affect

The 20-item Positive and Negative Affect Schedule (Watson et al., 1988) measured participants' daily positive and negative affect. Participants were asked to rate the extent to which they felt 20 emotions each day; sample items included "excited" (positive affect) and "scared" (negative affect). Respondents selected response options for each emotion ranging from 1 (*not at all*) to 5 (*extremely*). Ten items on each of the subscales were summed, with higher scores denoting higher levels of daily positive and negative affect (range = 10–50; Day 1 $\alpha_{\text{Negative Affect}} = 0.87$; Day 1 $\alpha_{\text{Positive Affect}} = 0.92$).

Daily perceived stress

Ten items adapted from the Perceived Stress Scale assessed participants' daily perceived stress (Cohen et al., 1983). Participants were instructed to select a number from 1 (*Strongly Disagree*) to 4 (*Strongly Agree*) to rate their agreement with a series of statements regarding several thoughts and feelings on each day. Sample items included "Today I was upset because of something that happened unexpectedly" and "Today I felt difficulties were piling up so high that I could not overcome them." Items were reverse-scored as necessary, with higher scores indicating a greater amount of global perceived stress on that day (range: 10–40; Day 1 $\alpha = 0.88$).

Daily pandemic worry

Two items that read "I am worried about the COVID-19 pandemic" and "My life feels completely different due to the COVID-19 pandemic" measured participants' daily pandemic worry. Participants were instructed to select a number from 1 (*Strongly Disagree*) to 4 (*Strongly Agree*). Higher scores indicated greater worry about the COVID-19 pandemic (range = 2–8; Day 1 $\alpha = 0.60$).

Analytic Approach

The current analyses involved fitting 3 two-level multilevel models in SAS Proc Mixed (Singer, 1998; Singer & Willett, 2003), nesting days (j; Level 1) within individuals (i; Level 2). Three models of increasing complexity were fit, including a main effects model (Model A), a two-way interaction effects model (Model B), and a three-way interaction effects model (Model C). In Model A, three within-person main effects tested for the within-person relationships between daily negative affect and (a) daily perceived stress (interpreted as *stress reactivity*; β_{20}), (b) daily pandemic worry (β_{30}), and (c) daily positive affect (β_{40}). The linear, within-person effect of days in the study was included as a Level 1 covariate to control for linear effects of time (β_{10}; Wang & Maxwell, 2015), and between-person relationships between average negative affect and (a) age (β_{01}), (b) average perceived stress (β_{02}), (c) average pandemic worry (β_{03}), and (d) average positive affect (β_{04}) were estimated at Level 2. To disaggregate within- and between-person effects, Level 1 predictors were person-mean centered, whereas Level 2

predictors were grand-mean centered (Curran & Bauer, 2011; Wang & Maxwell, 2015). Notably, random effects were estimated for all Level 1 predictors.

In Model B, we added two-way, within-person interaction effects that examined whether stress reactivity depended on daily positive affect (β_{50}) or pandemic worry (β_{70}), as well as whether the daily relationship between negative affect and pandemic worry depended on daily positive affect (β_{60}). Cross-level interaction effects were also added to test for age differences in stress reactivity (β_{21}), as well as the daily relationships between negative affect and both pandemic worry (β_{31}) and positive affect (β_{41}). Finally, in Model C, we added a within-person, three-way interaction effect that tested whether positive affect's moderating effect on stress reactivity depended on daily pandemic worry (β_{80}). We also added cross-level, three-way interaction effects that tested for age differences in positive affect's (β_{51}) and pandemic worry's (β_{71}) moderating effect on stress reactivity, as well as the interaction effect between daily pandemic worry and positive affect (β_{61}). Due to convergence issues, random effects were only estimated for the Level 1 main effects, as well as the interaction effect between daily stress and daily positive affect, in Models B and C. Model C's equation was specified as follows (Note that in the equations, NA = negative affect, PSS = perceived stress, COVID = pandemic worry, and PA = positive affect):

Level 1:

$$\begin{aligned}\mathrm{NA}_{ij} &= \pi_{0i} + \pi_{1i}\left(\mathrm{Day}_{ij} - 1\right) + \pi_{2i}\left(\mathrm{PSS}_{ij} - \mathrm{PSS}_{i.}\right) \\ &+ \pi_{3i}\left(\mathrm{COVID}_{ij} - \mathrm{COVID}_{i.}\right) + \pi_{4i}\left(\mathrm{PA}_{ij} - \mathrm{PA}_{i.}\right) \\ &+ \pi_{5i}\left(\mathrm{PSS}_{ij} - \mathrm{PSS}_{i.}\right)\left(\mathrm{PA}_{ij} - \mathrm{PA}_{i.}\right) \\ &+ \pi_{6i}\left(\mathrm{COVID}_{ij} - \mathrm{COVID}_{i.}\right)\left(\mathrm{PA}_{ij} - \mathrm{PA}_{i.}\right) \\ &+ \pi_{7i}\left(\mathrm{PSS}_{ij} - \mathrm{PSS}_{i.}\right)\left(\mathrm{COVID}_{ij} - \mathrm{COVID}_{i.}\right) \\ &+ \pi_{8i}\left(\mathrm{PSS}_{ij} - \mathrm{PSS}_{i.}\right)\left(\mathrm{COVID}_{ij} - \mathrm{COVID}_{i.}\right) \\ &\left(\mathrm{PA}_{ij} - \mathrm{PA}_{i.}\right) + r_{ij}\end{aligned}$$

Level 2:

$$\begin{aligned}\pi_{0i} &= \beta_{00} + \beta_{01}\left(\mathrm{Age}_{i.} - \mathrm{Age}..\right) + \beta_{02}\left(\mathrm{PSS}_{i.} - \mathrm{PSS}..\right) \\ &+ \beta_{03}\left(\mathrm{COVID}_{i.} - \mathrm{COVID}..\right) + \beta_{04}\left(\mathrm{PA}_{i.} - \mathrm{PA}..\right) + \xi_{0i}\end{aligned}$$

$$\pi_{1i} = \beta_{10} + \xi_{1i}$$

$$\pi_{2i} = \beta_{20} + \beta_{21}\left(\mathrm{Age}_{i.} - \mathrm{Age}..\right) + \xi_{2i}$$

$$\pi_{3i} = \beta_{30} + \beta_{31}\left(\mathrm{Age}_{i.} - \mathrm{Age}..\right) + \xi_{3i}$$

$$\pi_{4i} = \beta_{40} + \beta_{41}\left(\mathrm{Age}_{i.} - \mathrm{Age}..\right) + \xi_{4i}$$

$$\pi_{5i} = \beta_{50} + \beta_{51}\left(\mathrm{Age}_{i.} - \mathrm{Age}..\right) + \xi_{5i}$$

$$\pi_{6i} = \beta_{60} + \beta_{61}\left(\mathrm{Age}_{i.} - \mathrm{Age}..\right)$$

$$\pi_{7i} = \beta_{70} + \beta_{71}\left(\mathrm{Age}_{i.} - \mathrm{Age}..\right)$$

$$\pi_{8i} = \beta_{80}$$

Results

Preliminary Analyses

At Day 1, all variables of interest were related to one another in the expected directions. Negative affect (M = 15.16, SD = 5.67) was positively correlated with perceived stress (r = 0.69, n = 266, p < .001) and pandemic worry (r = 0.38, n = 265, p < .001) but negatively correlated with positive affect (r = –0.27, n = 267, p < .001). Additionally, perceived stress (M = 19.49, SD = 5.12) was positively related to pandemic worry (r = 0.43, n = 264, p < .001), yet negatively related to positive affect (r = –0.48, n = 266, p < .001). Lastly, pandemic worry (M = 5.90, SD = 1.41) was weakly, negatively related to positive affect (M = 29.04, SD = 7.78; r = –0.16, n = 265, p < .01). Because there were neither gender ($F(1, 347) = 0.70$, p = .402) nor race differences (coded 0 = *White/Caucasian*, 1 = *other* due to small group sizes; $F(1, 347) = 0.99$, p = .321) in average negative affect, these characteristics were not controlled for in the primary analyses. Finally, an unconditional means model revealed that 35% of the variance in negative affect resides within individuals (intraclass correlation coefficient = 0.65), and an unconditional growth model indicated that negative affect decreased across the study period ($\hat{\beta}_{10}$ = –0.05, p < .001).

Primary Analyses

Model A tested within- and between-person main effects of perceived stress, pandemic worry, and positive affect, as well as a between-person effect of age, on negative affect. Model parameter estimates are displayed in Table 1. Between individuals, those who were younger ($\hat{\beta}_{01}$ = –0.03, p < .01), as well as those with higher average perceived stress ($\hat{\beta}_{02}$ = 0.62, p < .001), average pandemic worry ($\hat{\beta}_{03}$ = 0.25, p < .05), or average positive affect ($\hat{\beta}_{04}$ = 0.13, p < .001) tended to have higher negative affect. Within individuals, when individuals experienced higher perceived stress ($\hat{\beta}_{20}$ = 0.43, p < .001) or pandemic worry ($\hat{\beta}_{30}$ = 0.20, p < .001), they also tended to experience higher negative affect. Thus, across the first month of the stay-at-home orders of the COVID-19 pandemic, individuals were not only stress-reactive but also were effectively reactive to pandemic worry.

Model B tested two-way interaction effects among the variables of interest. First, there was a significant within-person interaction effect between daily perceived stress and daily positive affect, indicating daily positive affect buffered daily stress reactivity ($\hat{\beta}_{50}$ = –0.01, p < .001; Figure 1). Next, there was a significant within-person interaction effect between daily perceived stress and pandemic worry such that daily pandemic worry exacerbated daily stress reactivity ($\hat{\beta}_{70}$ = 0.06, p < .001; Figure 2). There was no significant within-person interaction effect, however, between daily pandemic worry

Table 1. Model Parameter Estimates

Fixed effects estimates	Model A	Model B	Model C
Intercept ($\hat{\beta}_{00}$)	13.78***	13.69***	13.69***
BP age ($\hat{\beta}_{01}$)	−0.03**	−0.04***	−0.04***
Day ($\hat{\beta}_{10}$)	−0.04***	−0.04***	−0.04***
BP stress ($\hat{\beta}_{02}$)	0.62***	0.61***	0.61***
WP stress ($\hat{\beta}_{20}$)	0.43***	0.40***	0.40***
BP worry ($\hat{\beta}_{03}$)	0.25*	0.22*	0.22*
WP worry ($\hat{\beta}_{30}$)	0.20***	0.21***	0.24***
BP PA ($\hat{\beta}_{04}$)	0.13***	0.12***	0.12***
WP PA ($\hat{\beta}_{40}$)	−0.01	−0.01	−0.01
WP stress × WP PA ($\hat{\beta}_{50}$)		−0.01***	−0.01***
WP worry × WP PA ($\hat{\beta}_{60}$)		0.01	0.01
WP worry × WP stress ($\hat{\beta}_{70}$)		0.06***	0.06***
BP age × WP stress ($\hat{\beta}_{21}$)		−0.005***	−0.005***
BP age × WP worry ($\hat{\beta}_{31}$)		−0.001	−0.002
BP age × WP PA ($\hat{\beta}_{41}$)		0.000	−0.000
BP age × WP stress × WP PA ($\hat{\beta}_{51}$)			−0.000
BP age × WP worry × WP PA ($\hat{\beta}_{61}$)			−0.000
BP age × WP stress × WP worry ($\hat{\beta}_{71}$)			0.001
WP stress × WP PA × WP worry ($\hat{\beta}_{80}$)			0.01**

Note: Model A = main effects model; Model B = two-way interaction effects model; Model C = three-way interaction effects model; BP = between-person; PA = positive affect; WP = within-person; Stress = perceived stress; Worry = pandemic worry.
***$p < .001$, **$p < .01$, *$p < .05$.

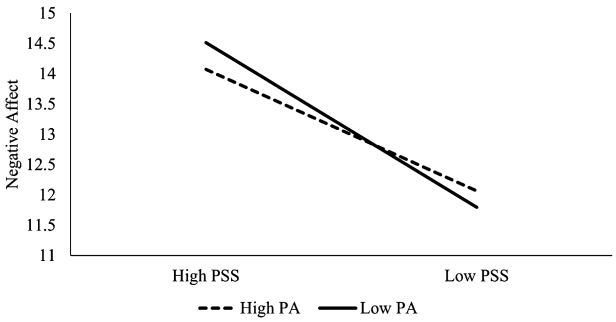

Figure 1. PSS = perceived stress; PA = positive affect; two-way, within-person interaction effect between daily perceived stress and daily positive affect. Although individuals experienced a higher negative affect on days that they experienced higher perceived stress, indicating stress reactivity, when individuals also experienced higher positive affect, they experienced weaker stress reactivity.

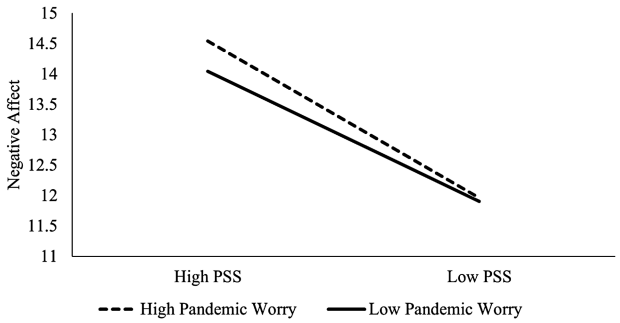

Figure 2. PSS = perceived stress; two-way, within-person interaction effect between daily perceived stress and daily pandemic worry. Although individuals experienced a higher negative affect on days that they experienced higher perceived stress, indicating stress reactivity, when individuals also experienced higher pandemic worry, they experienced higher stress reactivity.

and daily positive affect ($\hat{\beta}_{60}$ = 0.01, p = .146). Finally, there was a significant cross-level interaction effect between age and daily perceived stress, indicating that older individuals were less stress-reactive than younger individuals ($\hat{\beta}_{21}$ = −0.005, $p < .001$; Figure 3). There were no significant cross-level interaction effects between age and either daily positive affect ($\hat{\beta}_{41}$ = 0.000, p = .890) or daily pandemic worry ($\hat{\beta}_{31}$ = −0.001, p = .654).

Finally, Model C tested three-way interaction effects. Notably, there were no significant cross-level interaction effects. There were no age differences in the interaction effect between daily perceived stress and daily positive affect ($\hat{\beta}_{51}$ = −0.000, p = .261), daily perceived stress and daily pandemic worry ($\hat{\beta}_{71}$ = 0.001, p = .452), or daily pandemic worry and daily positive affect ($\hat{\beta}_{61}$ = −0.000, p = .778). There was a significant three-way, within-person interaction effect among daily perceived stress, daily pandemic worry, and daily positive affect, however, indicating that on days individuals were more worried about the pandemic, positive affect's buffering effect on stress reactivity was weaker ($\hat{\beta}_{80}$ = 0.01, $p < .01$; Figure 4).

Discussion

In summary, the current findings indicated that early in the COVID-19 pandemic, individuals' daily stress reactivity was moderated by age, daily pandemic worry, and/

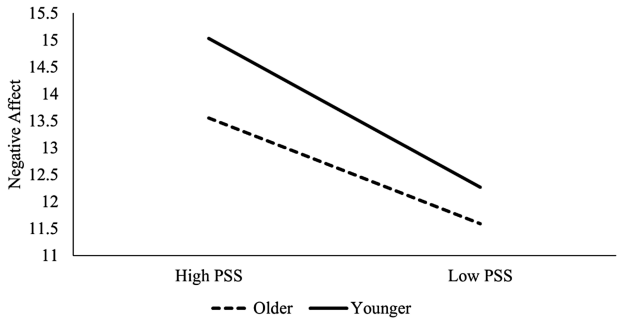

Figure 3. PSS = perceived stress; two-way, cross-level interaction effect between daily perceived stress and age. Although individuals experienced a higher negative affect on days that they experienced higher perceived stress, indicating stress reactivity, younger individuals experienced higher stress reactivity than older individuals.

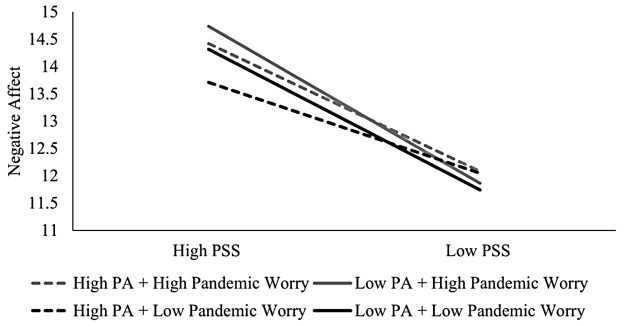

Figure 4. PSS = perceived stress, PA = positive affect; three-way, within-person interaction effect among daily perceived stress, positive affect, and pandemic worry. Although daily positive affect buffered daily stress reactivity, this effect was weaker on days that individuals were more worried about the pandemic.

or daily positive affect. The current study derived four key findings. First, older individuals were less stress-reactive than younger individuals. Second, individuals were less stress-reactive on days they also experienced higher positive affect. Third, individuals were more stress-reactive on days they were also more worried about the pandemic. Fourth, individuals' buffering effect of positive affect was stronger on days they were also less worried about the pandemic. Thus, all moderators of interest were related to daily stress reactivity early in the COVID-19 pandemic.

Because COVID-19 hospitalization rates increase with age (Centers for Disease Control and Prevention, 2020), one might have expected, contrary to our hypothesis and finding, that older individuals would be more stress-reactive than younger individuals during this time. Notably, Park et al. (2020) found that younger individuals tended to use fewer productive coping strategies such as substance use during the COVID-19 pandemic than older individuals. Higher risk perception among younger individuals (Bruine de Bruin, 2020), paired with less-effective coping strategies (Park et al., 2020), may deplete coping resources and thus heighten stress reactivity (Almeida, 2005; Folkman, 2008). Practitioners might intervene with younger individuals' stress reactivity by promoting more effective coping strategies such as actively coping with the stressor or obtaining social support (Park et al., 2020).

Extending prior between-person findings, a within-person interaction effect indicated that individuals were more stress-reactive on days that they were particularly worried about the pandemic. Indeed, prior studies indicated individual differences in pandemic worry and expectations were associated with behavioral changes, as well as appraised stress and negative affect, respectively (Barber & Kim, 2020; Whitehead, 2020). Additionally, between individuals, the most reported COVID-19-related stressor was news exposure (Park et al., 2020; Whitehead & Torossian, 2020). Looking within individuals, stress reactivity was higher *when* individuals were more concerned about the pandemic than usual. Perhaps daily variation in exposure to COVID-19-related stressors like news exposure drove daily variation in pandemic worry, which, in turn, exacerbated stress reactivity. This possibility, however, remains to be tested.

The protective effect of positive affect against stress reactivity found in the current study has been previously found under typical circumstances (Leger et al., 2020; Ong et al., 2006), as well as amidst a common chronic stressor (i.e., bereavement; Ong et al., 2006). Therefore, the current study replicates and extends previous work. Because the mobilization of positive affect may have salubrious effects on individuals' mental health as the pandemic runs its course, practitioners and caregivers may consider ways to increase the experience of positive emotion at home. Notably, engagement in leisure activities is associated with positive affect (Kuykendall et al., 2015). This effect was strongest when activity engagement was measured in terms of breadth of engagement as opposed to quantity of engagement, which indicates that partaking in a variety of activities confers the most benefits in terms of enhancing positive affect. Therefore, engagement in a variety of leisure activities that could reasonably be done around the house during the COVID-19 pandemic (e.g., reading, gardening, cooking, exercising, creative endeavors) may be a promising means of mobilizing positive affect and thus, buffering stress reactivity.

Finally, although individuals generally experienced lower stress reactivity on days that they also experienced higher positive affect, this buffering effect was weaker on days that individuals were also particularly worried about the COVID-19 pandemic. Thus, daily pandemic worry was not only consequential to stress reactivity, but also to the buffering effect of positive affect. Perhaps behavioral changes such as limiting exposure to news coverage would have reduced daily pandemic worry. Indeed, the early stages of the COVID-19 pandemic were marked by lengthy press conferences, positivity rate announcements, and emergency directive updates. Statewide emergency

directives were continually renewed and updated, and there was widespread uncertainty in terms of when the pandemic and its associated restrictions would end (Whitehead & Torossian, 2020). Perhaps individuals were less worried about the pandemic on days they did not attend to such information, which ultimately freed up coping resources that supported a more robust buffering effect of positive affect on stress reactivity (Folkman, 2008). Thus, engagement in behaviors that not only mobilize positive affect, but also decrease pandemic worry, may have been important coping behaviors early in the COVID-19 pandemic. This causal mechanism, however, remains to be tested.

Limitations

Although the current findings are informative in terms of daily stress processes early in the COVID-19 pandemic, several limitations must be considered. First, the current study occurred immediately after the stay-at-home orders began; therefore, the current findings may differ from those obtained later in the pandemic as emergency directives begin to lift. The current findings may be particularly relevant, however, in the case of future stressors that affect large groups of people, and contribute to the current paucity of research regarding the effects of the initial stay-at-home orders on daily stress processing (Klaiber et al., 2020). Next, the current study cannot elucidate the temporal ordering of effects. Although our models specified negative affect as the outcome of perceived stress and other moderating variables, the opposite effects are also possible. Relatedly, the current findings can only speak to affective reactivity to stress, as opposed to physiological reactivity. Notably, however, daily, concurrent affective stress reactivity has been linked to physical and mental health (Charles et al., 2013; Piazza et al., 2013). Thus, the current results likely have implications for long-term health and well-being, even without elucidation of temporal ordering or direct measurement of physiological stress reactivity.

There are two limitations to measurement. First, there is no available information on the psychometric properties of the pandemic worry variable used in the current analyses, as these scores were derived from two items designed by the researchers for use in the current study. Second, the current study's perceived stress variable includes information on stressors that are directly related to COVID-19, such as news exposure, as well as stressors that may not be related to COVID-19, such as work deadlines. Given the evidence for differential age relationships with reactivity to these different types of stressors (Klaiber et al., 2020), future work may examine whether positive affect and pandemic worry differentially moderate reactivity to these stressors as well. Given that chronic stress in one aspect of life can affect daily reactivity to stressors in other aspects of life (Serido et al., 2004); however, even non–COVID-19-related stressors, such as work deadlines, are likely made more stressful by the COVID-19 pandemic and its related disruptions to daily life (Klaiber et al., 2020). Indeed, stress and context are inextricably tied; thus, COVID-19-related stressors cannot be truly separated from non–COVID-19-related stressors.

Conclusions

The mobilization of positive affect may be one avenue for intervention in daily stress processes during the COVID-19 pandemic. Its daily effectiveness on this process, however, varies with pandemic worry. Indeed, on days individuals were particularly worried about the COVID-19 pandemic, positive affect's buffering effect on daily stress reactivity was weaker. Thus, by engaging in activities that promote positive affect and quell pandemic worry, individuals may buffer stress reactivity early in the COVID-19 pandemic, and thus, during future universal stressors.

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Conflict of Interest

None declared.

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