Flourishing and its Associations with Affective Reactivity and Recovery to Daily Stress

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Abstract

There are marked individual differences in the impact of daily stress on health. We use trait measures of well-being, here quantified as flourishing, and daily reports of stress and negative mood to test (i) the moderating effects of flourishing on affective reactivity and recovery in response to increases in daily stress. To examine whether high curiosity acts as a resource to diminish stress effects, we additionally test (ii) the association between flourishing and curiosity and (iii) the associations between day's curiosity and both affective reactivity and recovery. We then test for (iv) prospective associations between affective reactivity and recovery and change in flourishing over 3 months. People high in flourishing show lower affective reactivity and augmented recovery. Participants high in flourishing exhibit more frequent days of high curiosity and high curiosity buffers the effects of stress on day's mood. Finally, greater affective reactivity is associated with longitudinal decreases in flourishing.

Keywords: flourishing; stress reactivity; curiosity; depressed mood; daily diary

INTRODUCTION

Stressors come in a variety of forms, including major life events such as bereavement or marital separation (Holmes & Rahe, 1967) and everyday hassles such as arguments with family members or deadlines at work (Almeida, 2005). Although seemingly minor when contrasted with major events, daily stressors are frequent (Almeida et al., 2002; Stawski et al., 2008), have immediate and direct effects on physical and emotional functioning (Fosco & Lydon-Staley, 2017; Stawski et al., 2013), and their effects on health and well-being can accumulate over time (Chiang et al., 2018; Parrish et al., 2011). Further, there are pronounced individual differences in the extent to which distress is experienced following exposure to daily stressors (Gunthert et al., 1999; Koffer et al. 2019). These individual differences have implications for resilience against poor health and well-being given that persistent emotional responses to daily stressors tax biological resources and cause long-term dysregulation of the physiological stress response (McEwen, 2006; McEwen, 1998). Here, we examine trait well-being as an individual difference that may moderate the effects of daily stress on negative affect.

Capturing vulnerability and resilience to daily stressors via daily diary methodology

The study of daily stressors benefits from research designs that incorporate intensive repeated measures: repeated assessments of individuals, typically *in situ*, to capture day-to-day fluctuations in behaviors of interest and during daily life (Bolger et al., 2003; Ram & Gerstorf, 2009). Capturing within-person fluctuations can facilitate the examination of stress, which is a process that occurs within the individual over time (Almeida, 2005; Molenaar, 2004). With time series data consisting of day-to-day fluctuations in daily stressors and mood, researchers can quantify how days of increased stress are associated with changes in an individual's mood. The

affective reactivity that occurs in response to stress, measured by examining increases in depressed mood following increases in stress, for example, prospectively predicts psychological distress (Charles et al., 2013; O'Neill et al., 2004). Further, *affective recovery* following daily stress can be examined by quantifying lingering negative affective responses present at some delay following the experience of stress (e.g., the next day; Leger et al., 2018). Recent findings show that individuals with higher levels of lingering negative affect and, thus, lower affective recovery, experience a greater number of chronic conditions and worse functional limitations ten years later (Leger et al., 2018). The presence of psychopathology, including depression for example, is associated with unique, often exaggerated affective reactivity to daily stress relative to healthy individuals (Myin-Germeys et al., 2003) as well as more lingering of negative affect responses to negative events (Peeters et al., 2003). The presence of well-being, however, is not simply the absence of psychopathology (Keyes, 2002), necessitating investigations into how well-being specifically may act as a moderator of individuals' responses to daily stressors.

Flourishing and the response to daily stressors

Flourishing is a measure of psychosocial well-being which reflects how well an individual is able to function emotionally, psychologically, and socially (Huppert & So, 2013; Keyes, 2007; Keyes, 2002). The many benefits associated with high flourishing have led to calls for examinations of the daily lives of people who flourish and those who do not to provide insight into the processes and experiences that facilitate flourishing (Catalino & Fredrickson, 2011; Schotanus-Dijkstra et al., 2016). One possible explanation for the positive outcomes associated with flourishing is that flourishing promotes more adaptive affective responses to daily-life stress.

One resource in particular that flourishers may leverage to realize adaptive responses to stress is a capacity to approach stressful life events with an attitude of curiosity. Curiosity is associated with a desire to learn from experiences, especially challenging experiences. During states of curiosity, people are less defensive, less reactive to discomfort and difficulties, and more tolerant of uncertainty (Denneson et al., 2017; Kashdan et al., 2013; Silvia, 2005). When curious, problems are more likely seen as challenges to be solved rather than uncontrollable setbacks. A related literature on mindfulness, often defined in terms of curiosity about the present moment (Bishop et al., 2004; Langer, 1989), provides additional evidence that curiosity may diminish affective reactivity to stress (Britton et al., 2012; Hoge et al., 2013) and reduce ruminative responses that prolong distress after the fact, encouraging recovery (Coffey et al., 2010). People high in flourishing show a greater tendency to experience high and consistent levels of curiosity in daily life (Gallagher & Lopez, 2007; Lydon-Staley et al., 2018). Consequently, we asked whether states of curiosity, reflecting a more adaptive approach to dealing with stressors, might moderate the association between daily stress and negative affect.

The present study

We extend understanding of the association between flourishing and daily stressors in several ways, all making use of daily diary data in response to calls for the use of intensive longitudinal data to help identify modifiable antecedents of flourishing (Catalino & Fredrickson, 2011; Schotanus-Dijkstra et al., 2016). First, we examine the extent to which trait flourishing moderates the association between daily stress and depressed mood. We capture both affective reactivity and affective recovery by examining the association between increases in stress and depressed mood on the day of (i.e., reactivity) and the day following (i.e., recovery) increases in stress. We hypothesize that depressed mood will be increased on days of greater than usual stress

and days following increases in stress. We further hypothesize that this association will be moderated by flourishing such that participants high in flourishing will demonstrate greater resilience to increases in depressed mood following increases in the experience of stress. Second, to provide greater insight into the mechanisms that may render participants high in flourishing resilient to increases in daily stress, we build on prior work showing that participants high in flourishing will exhibit high levels of curiosity during daily life (Lydon-Staley et al., 2018) and examine how day's curiosity moderates the association between daily stress and depressed mood. We hypothesize that participants high in flourishing will exhibit high levels of curiosity during daily life and that the association between day's stress and depressed mood will be attenuated on days of higher than usual curiosity. In order to ascertain long-term effects of affective responses to stress on well-being, we examine prospective associations between ratings of flourishing taken approximately three months apart and affective reactivity and recovery in response to daily stress. We hypothesize that greater affective reactivity and diminished recovery following increases in stress will undermine flourishing over time.

MATERIALS AND METHODS

We made use of data from the Knowledge Networks Over Time (KNOT) study, an intensive longitudinal study designed to provide insight into day-to-day intraindividual variability across a range of domains of functioning, in particular curiosity (Lydon-Staley et al., 2018). Data and code used in the manuscript are available upon request from the corresponding author.

Participants

Participants were 167 individuals (136 female, 29 male, 2 other gender) recruited through poster, Facebook, Craigslist, and university research site advertisements in Philadelphia and the

surrounding university community. Individuals were eligible if they met 4 criteria: 1) aged between 18 and 65 years; 2) consistent access to a computer connected to the internet at home; 3) willingness to complete 21 consecutive days of surveys; 4) willing to visit the research laboratory for 1 hour. Participants were aged between 18.21 and 65.24 years ($M = 25.37$, $SD = 7.34$), and identified as White (49.10%), African American/Black (8.38%), Asian (23.35%), Hispanic/Latino (4.79%), Multiracial (6.59%), other (5.39%), and missing information (2.40%). Participants identified as bisexual (7.78%), gay (4.19%), heterosexual (79.04%), lesbian (1.20%), other (5.99%), and missing information (1.80%). Participants reported a yearly family income ranging from 'under \$20,000' to '\$200,000 or more' (*Modal income* = '\$20,000 - \$49,000'). Participants' education spanned less than a high school degree (0.60%), high school degree (8.98%), associate's degree or some college but no degree (30.54%), college degree (37.72%), graduate or professional training (20.96%), or missing information (1.20%).

Procedure

Interested participants encountered study advertisements and were directed to a website with study information and a consent form. After confirming that participants met inclusion criteria, participants were contacted by telephone with a description of the study and an opportunity to assent or decline participation. If individuals assented, an email was sent with a baseline survey containing demographic questionnaires, the curiosity measure, the depression measure, the life satisfaction measure, and the flourishing scale used in the present study. The baseline survey also contained additional scales that were not the focus of the present study. Once the baseline survey was completed, participants completed a laboratory session. At the laboratory session,

participants completed additional questionnaires, received training in the daily assessment protocol, and were guided through the installation of an app necessary for an internet browsing study component that we do not report on in the present manuscript.

Following the laboratory study, a 21-day diary assessment protocol was initiated. The 21-day diary assessment consisted of two components. The first was a daily diary consisting of survey questionnaires that took approximately 5 minutes to complete. The second came immediately after the daily diary component and was a 15-minute internet browsing task that we do not report on in the present manuscript (but see Lydon-Staley et al., 2019a for details). Links to the daily assessments were emailed to participants at 6:30 PM each evening. Participants who requested reminders received a text message at 6:40 PM to notify them that survey links had been emailed. Participants were instructed to complete the daily assessments before going to bed, but links remained open until 10:00 AM the next morning. In cases where participants completed the surveys the following morning, they were instructed to report as if they were completing the survey on the previous evening. Daily questionnaires took approximately 5 minutes to complete.

Participants were compensated with gift cards to Amazon.com at each study phase. Participants received \$25 after completing the baseline assessment and the laboratory visit. For the daily assessment, completion was incentivized by making participant payment contingent on completion: completion of 3, 4, 5, 6, and 7 surveys each week was compensated with gift cards worth \$10, \$15, \$20, \$25, and \$35, respectively. Participation was further incentivized through a raffle for which an iPad mini was available as a prize. Completion of 7 surveys each week resulted in one entry into the raffle drawing. A follow-up survey was emailed to participants approximately three months following baseline survey completion. This survey was similar to the baseline survey, allowing an examination of longitudinal change.

Measures

The present study made use of participants' reports of demographic and trait characteristics from the baseline surveys, their daily diary reports, and flourishing from their three-month follow-up survey. Means, standard deviations, and correlations among the measures used below can be found in Table 1.

Flourishing. Flourishing was measured at both baseline and the three-month follow-up survey using an 8-item flourishing scale (Diener et al., 2010). The flourishing scale contains items related to important aspects of human functioning, including positive relationships, feelings of competence, and having meaning and purpose in life. Flourishing scale items are answered on a 1 (“Strong Disagreement”) to 7 (“Strong Agreement”) scale. The mean value of all 8 items was taken as a measure of flourishing, with higher values indicating relatively higher levels of flourishing. The scale demonstrated high internal consistency in the current sample at both baseline ($\alpha = 0.90$) and three-month follow-up ($\alpha = 0.94$).

Depressed Mood. Depressed mood was measured using the average of two items adapted from the Profile of Mood States (Terry et al., 2003): “How much of the time today did you feel depressed?” and “How much of the time today did you feel sad or blue”. Both items have been used in previous experience-sampling studies (Lydon-Staley et al., 2019b). Participants rated their depressed mood using a slider ranging from 0 (“None of the time”) to 10 (“All of the time”) in 0.1 increments. Reliability analysis appropriate for daily diary data (Cranford et al., 2006) indicated that the scale could reliably capture both systematic within-person change in depressed mood ($R_c = 0.82$) and between-person differences in depressed mood across the daily diary period ($R_{1F} = 0.84$).

Daily Stress. Daily stress was measured through the daily diary component of the study. The measure was based on previous experience-sampling work on stress in daily life (Koffer et al., 2019). Participants responded to the items “Today I felt difficulties were piling up so high I could not overcome them” and “Today I felt stressed” on a scale of 0 (“Never”/ “Not at all”) to 10 (“Very Often”/ “Strongly”) in increments of 0.1. The average of the two daily stress items was taken to create a daily stress scale. Reliability analysis for daily diary data indicated that the scale could reliably capture both systematic within-person change in stress ($R_c = 0.79$) and between-person differences in stress across the daily diary period ($R_{1F} = 0.81$).

Daily Curiosity. Daily curiosity was measured during the daily diary component of the study using 2-items from the Curiosity and Exploration Inventory II (CEI-II; Kashdan et al., 2009) that have been used in previous studies of daily curiosity (e.g., Kashdan et al., 2013). Participants responded to two items. One item, "Today, I viewed challenging situations as an opportunity to grow and learn", was derived from the embracing subscale of the CEI-II and was designed to provide insight into a willingness to embrace the novel, uncertain, and unpredictable nature of everyday life. A second item, "Everywhere I went today, I was out looking for new things or experiences", was derived from the stretching subscale of the CEI-II and was designed to provide insight into the motivation to seek out knowledge and new experiences. Participants responded to the items on a slider ranging from 0 ("Not at all") to 10 ("Very") in increments of 0.1. A repeated measures correlation (Bakdash et al., 2017) indicated that the two items were moderately correlated, $r_{rm}=0.45$, $p<0.001$. Responses across the items were averaged to form a daily curiosity scale, with higher values indicating higher levels of curiosity. Reliability analysis indicated that the scale was satisfactory in reliably capturing both systematic within-person

change in stress ($R_c=0.62$) and between-person differences in stress across the daily diary period ($R_{1F}=0.81$).

Data Analysis

Three main questions guided our analyses. First, we examined the extent to which flourishing moderated the effects of today's stress and yesterday's stress on depressed mood, or affective reactivity and affective recovery, respectively. Second, we examined the association between curiosity experienced on a given day and both affective reactivity and affective recovery. Finally, we examined the extent to which between-person differences in affective reactivity and affective recovery of depressed mood in response to daily stress were associated with decreases in flourishing over a 3-month period.

Testing the association between flourishing and depressed mood reactivity and recovery following daily stress. A multilevel model framework was adopted to accommodate the nested nature of the intensive repeated measures data (21 days nested within 167 persons). To facilitate a focus on within-person associations between the current day and previous day's stress and depressed mood, the predictor variables were parameterized to separate within-person and between-person associations. This parameterization was achieved by creating time-invariant (between-person) and time-varying (within-person) versions of the predictor variables (Bolger & Laurenceau, 2013). We calculated the time-invariant, between-person variable for *usual stress* as the grand-mean centered individual mean score of daily stress across all days in the daily diary study. Participants with a positive value on this variable had greater than usual levels of stress throughout the study compared with other participants in the sample. We calculated a time-varying, within-person version of the daily stress variable as deviations from these between-person, *usual stress*, means. Thus, zero on this within-person variable indicated days of usual levels of

stress, negative values indicated days of less than usual levels stress, and positive values indicated days of more than usual stress for each individual. The stressor variables were then included in a multilevel model to estimate associations between daily reports of stress and depressed mood and the extent to which these associations were moderated by person-to-person differences in flourishing. At Level 1 (day-level variables) the formal model was constructed as:

$$\begin{aligned} DepressedMood_{it} = & \beta_{0i} + \beta_{1i}Day'sStress_{it} + \beta_{2i}PreviousDay'sStress_{it} + \\ & \beta_{3i}DayOfStudy_{it} + e_{it} \end{aligned} \quad (1)$$

where β_0 is the intercept, indicating the average level of depressed mood for the prototypical female (all predictors were sample-mean centered except for gender which was dummy coded such that female was the reference category); β_{1i} indicates within-person differences in depressed mood associated with within-person differences in today's stress to capture affective reactivity; β_{2i} indicates within-person differences in the day's depressed mood associated with within-person differences in previous day's stress to capture affective recovery; β_{3i} indicates the effect of the day of study, in order to control for time as a variable (Bolger & Laurenceau, 2013). Lastly, e_{it} are autocorrelated day-specific residuals (AR1).

Person-specific intercepts and associations (from Level 1) were specified (at Level 2) as:

$$\begin{aligned} \beta_0 = & \gamma_{00} + \gamma_{01}Flourishing_i + \gamma_{02}UsualStress_i + \gamma_{03}Age_i + \gamma_{04}GenderMale_i + \\ & \gamma_{05}GenderOther_i + u_{0i} , \\ \beta_1 = & \gamma_{10} + \gamma_{11}Flourishing_i + u_{1i} , \\ \beta_2 = & \gamma_{20} + \gamma_{21}Flourishing_i + u_{2i} , \end{aligned}$$

$$\beta_3 = \gamma_{30} , \quad (2)$$

where γ denotes a sample-level parameter and u denotes residual between-person differences that may be correlated, but are uncorrelated with e_{it} . Parameters γ_{01} to γ_{05} indicate how between-person differences in the average level of depressed mood across the daily diary protocol were associated with flourishing, usual levels of stress, participant age, and participant gender. Parameter γ_{11} tests the moderating effect of trait flourishing on the association between today's stress and today's depressed mood. Parameter γ_{21} tests the moderating effect of trait flourishing on the association between previous day's stress and today's depressed mood. The multilevel model was fit with nlme in R (Pinheiro et al., 2012) and incomplete data were treated using the assumption of being missing at random. We further probed significant interactions using the Johnson-Neyman technique (Bauer & Curran, 2005).

Probing curiosity as a moderator of daily stress' associations with depressed mood.

Once the moderating effect of flourishing on the association between daily stress and depressed mood was tested, we examined the role of curiosity as a stress-buffering resource in explaining the observed associations. We first confirmed that curiosity was significantly correlated with flourishing (see also Lydon-Staley et al., 2018). Then, using the same procedure as described for daily stress in Equation 1, we parameterized the daily curiosity variable into between-person and within-person components. Then, we constructed a multilevel model. At Level 1 (day-level variables), the formal model was constructed as:

$$\begin{aligned}
DepressedMood_{it} = & \beta_{0i} + \beta_{1i}Day'sStress_{it} + \beta_{2i}PreviousDay'sStress_{it} + \\
& \beta_{3i}Day'sCuriosity_{it} + \beta_{4i}DayOfStudy_{it} + \beta_{5i}Day'sCuriosity_{it} * Day'sStress_{it} + \\
& \beta_{6i}Day'sCuriosity_{it} * PreviousDay'sStress_{it} + e_{it}
\end{aligned} \tag{3}$$

where $DepressedMood_{it}$ is depressed mood for person i on day t ; β_0 is the intercept, indicating the average level of depressed mood for the prototypical female (as before, all predictors were sample-mean centered except for gender which was dummy coded such that female was the reference category); β_{1i} indicates within-person differences in depressed mood associated with within-person differences in day's stress (affective reactivity); β_{2i} indicates within-person differences in depressed mood associated with within-person differences in the previous day's stress (affective recovery); β_{3i} indicates within-person differences in depressed mood associated with within-person differences in day's curiosity; β_{4i} indicates the effect of the day of study to control for time as a third variable; β_{5i} examines the moderating effect of day's curiosity on affective reactivity; β_{6i} examines the moderating effect of day's curiosity on affective recovery; lastly, e_{it} are autocorrelated day-specific residuals (AR1).

Person-specific intercepts and associations (from Level 1) were specified (at Level 2) as:

$$\begin{aligned}
\beta_0 = & \gamma_{00} + \gamma_{01}UsualStress_i + \gamma_{02}UsualCuriosity_i + \gamma_{03}Age_i + \gamma_{04}GenderMale_i + \\
& \gamma_{05}GenderOther_i + u_{0i} \\
\beta_1 = & \gamma_{10} + u_{1i} , \\
\beta_2 = & \gamma_{20} + u_{2i} , \\
\beta_3 = & \gamma_{30} + u_{3i} , \\
& \dots
\end{aligned}$$

$$\beta_6 = \gamma_{60} , \quad (4)$$

where γ denotes a sample-level parameter and u denotes residual between-person differences that may be correlated, but are uncorrelated with e_{it} . Parameters γ_{01} to γ_{06} indicate how between-person differences in the average level of depressed mood across the daily diary protocol were associated with usual levels of stress, curiosity, participant gender, and participant age. The interaction between previous day's stress and day's curiosity was not significant and was therefore removed from the final model.

Change in flourishing and its association with affective reactivity and recovery. Previous work indicates prospective effects of negative affect reactivity and recovery from daily stress on mental and physical health (Leger et al., 2018; Piazza et al., 2013). In order to analyze the association between affective reactivity and recovery from daily stress on change in flourishing, we use multilevel models to compute an estimate of affective reactivity and recovery for each individual in the sample. At Level 1 (day-level variables) the formal model was constructed just as displayed in Equation 1 above:

$$\begin{aligned} DepressedMood_{it} = & \beta_{0i} + \beta_{1i}Day'sStress_{it} + \beta_{2i}PreviousDay'sStress_{it} + \\ & \beta_{3i}DayOfStudy_{it} + e_{it} \end{aligned} \quad (5)$$

where $DepressedMood_{it}$ is depressed mood for person i on day t ; β_0 is the intercept, indicating the average level of depressed mood; β_{1i} indicates within-person differences in depressed mood associated with within-person differences in day's stress (affective reactivity); β_{2i} indicates within-person differences in depressed mood associated with within-person differences in the

previous day's stress (affective recovery); β_{3i} indicates the effect of the day of study to control for time as a third variable. Lastly, e_{it} are autocorrelated day-specific residuals (AR1).

Person-specific intercepts and associations (from Level 1) were specified (at Level 2) as:

$$\begin{aligned}\beta_0 &= \gamma_{00} + \gamma_{01} UsualStress_i + u_{0i} , \\ \beta_1 &= \gamma_{10} + u_{1i} , \\ \beta_2 &= \gamma_{20} + u_{2i} , \\ \beta_3 &= \gamma_{30} ,\end{aligned}\tag{6}$$

where γ denotes a sample-level parameter and u denotes residual between-person differences that may be correlated, but are uncorrelated with e_{it} . The random effects u_{1i} and u_{2i} were extracted as person-specific estimates of affective reactivity and affective recovery from daily stress, respectively. Higher values on the affective reactivity variable indicate greater increases in depressed mood on days of increased stress. Higher values on the affective recovery variable indicate more lingering depressed mood in response to previous day's stress. Notably, γ_{01} controls for differences in the association between usual levels of stress and depressed mood, allowing a focus on the within-person associations between increases in daily stress and depressed mood. We controlled for age and gender in the next analysis step and, as such, did not include them in the multilevel model (see Leger et al., 2018). The multilevel model was fit with the nlme package in R (Pinheiro et al., 2012).

We then estimated change in flourishing between baseline and three-month follow-up by creating a difference score (Castro-Schilo & Grimm, 2018), subtracting each subjects' baseline score for flourishing from the three-month follow-up score for flourishing. Positive values on

this change in flourishing variable indicate increases in flourishing across the two time points while negative values indicate decreases in flourishing. We tested the extent to which both affective reactivity and affective recovery to daily stress were associated with changes in flourishing over the three-month period using a multiple regression model of the form:

$$\text{ChangeInFlourishing}_i = \beta_0 + \beta_1 \text{AffectiveReactivity}_i + \beta_2 \text{AffectiveRecovery}_i + \beta_3 \text{Age}_i + \beta_4 \text{GenderMale}_i + \beta_5 \text{GenderOther}_i \quad (7)$$

where β_0 is the intercept, indicating the change in flourishing for the prototypical female (all predictors were sample-mean centered except for gender which was dummy coded such that female was the reference category); β_1 represents individual differences in affective reactivity (u_{1i} from equation 4); β_2 represents individual differences in affective recovery (u_{2i} from equation 4); β_3 controls for participant age; β_4 compares change in flourishing for males relative to females; and β_5 compares change in flourishing for participants reporting other genders relative to females.

RESULTS

We provide descriptive statistics for the variables used in the analyses in Table 1. Out of a possible total of 3507 daily diary days (21 days x 167 participants), 3141 (89.56%) were available. The number of daily diary days available per participant ranged from 11 to 21 ($M = 18.81$, $SD = 2.75$). No significant correlations emerged between key study variables (those listed in Table 1) and the number of days of data obtained from each participant (all p -values > 0.05).

Associations between flourishing and affective reactivity and recovery following daily stress

First, we conducted analyses to address our initial question of whether individuals higher in flourishing experienced lower affective reactivity and quicker recovery to increases in daily stress. Results from the multilevel model testing the association between flourishing and stress' effect on depressed mood are shown in Table 2. A significant interaction emerged between day's stress and flourishing ($\gamma_{11}=-0.06, p=0.04$). Considering the interaction further, we found that the association between day's stress and depressed mood was significant and positive at all values of flourishing, but that the slope between day's stress and depressed mood was steeper at lower values of flourishing (Figure 1A).

Additionally, a significant interaction emerged between previous day's stress and flourishing ($\gamma_{11}=-0.04, p=0.03$). Considering this interaction further, we found that the association between previous day's stress and depressed mood was significant and positive at values of sample-mean centered flourishing below -1.57 (the minimum value of flourishing was -4.16 and the maximum value was 1.09), but not significant at values above -1.57. As shown in Figure 1B, participants with higher flourishing scores experienced no increase in depressed mood on days following increases in stress. By contrast, participants with lower flourishing scores experienced increases in depressed mood on days following increases in stress.

We examined model covariates to examine their associations with depressed mood. Depressed mood was not associated with time in study, age, or gender (all p -values > 0.05). Participants experiencing relatively higher stress throughout the daily diary period exhibited greater depressed mood throughout the daily diary ($\gamma_{11}=0.44, p<0.001$), indicating between-person associations between stress and depressed mood in addition to the observed within-person associations.

Day's curiosity as a moderator of stress's association with depressed mood

Next, we confirm that participants high in curiosity also exhibit higher average curiosity across the daily diary period ($r(165)=0.25, p=0.001$). We then examined curiosity's moderating effect on affective reactivity and recovery, to address the question of whether curiosity might be a resource that contributes to diminished affective responses to stress observed in participants high in flourishing. Results of the multilevel model examining the moderating effect of day's curiosity on the association between day's stress and depressed mood are shown in Table 3. There was a significant interaction between day's stress and day's curiosity ($\gamma_{51}=-0.04, p<0.001$). Considering the interaction further showed that the association between day's stress and depressed mood was significant for values of day's curiosity below 3.89 (day's curiosity ranged between -6.79 to 8.70). As shown in Figure 1C, on days of higher than usual curiosity, the association between day's stress and depressed mood was attenuated.

Affective reactivity and recovery and change in flourishing

Next, we asked whether affective reactivity and recovery were associated with change in flourishing over time (Table 4), to assess whether daily responses to stress might undermine flourishing in the future. Here, we found that the predictors as a whole did not explain a significant amount of variance in changes in flourishing ($R^2=0.03, F(5, 158)=0.95, p=0.45$). Affective reactivity was negatively associated with change in flourishing ($\beta=-0.55, p=0.04$), such that participants experiencing greater increases in day's depressed mood in response to increases in stress exhibited greater decreases in flourishing (Figure 1D). Affective recovery was not associated with change in flourishing ($\beta=-0.43, p=0.77$). Neither age nor gender were associated with

change in flourishing (all p -values > 0.05). A model without the non-significant covariates suggested that affective reactivity explained a significant, albeit small, amount of variance in change in flourishing ($R^2=0.03$, $F(1, 162)=4.59$, $p=0.03$).

Discussion

Flourishing is a state of optimal emotional, psychological, and social wellbeing characterized by frequent positive affect (Keyes, 2007). Given the many benefits associated with flourishing, there have been recent calls for the examination of the daily lives of people who flourish to provide insight into the processes and experiences that facilitate flourishing (Catalino & Fredrickson, 2011; Schotanus-Dijkstra et al., 2016). Here, we examined the extent to which trait flourishing derives from more adaptive affective responses to increases in daily-life stress. To test this proposition, we quantified individual differences in depressed mood reactivity and recovery following exposure to increases in daily stress and observed that both affective reactivity and recovery are attenuated in participants high in flourishing.

Flourishing may both buffer against reactivity and support quicker recovery following daily stress experiences through a variety of means. Curiosity is a particularly important resource that people high in flourishing gain due to their propensity for enduring positive affect (Fredrickson, 2005; Fredrickson, 2001; Gallagher & Lopez, 2007; Lydon-Staley et al., 2018) and a means through which people high in flourishing may avoid high affective reactivity and slow affective recovery. Indeed, in the current data, we observed that individuals high in flourishing experience higher average levels of curiosity during the daily diary period of the study. Consistent with evidence that curiosity makes individuals more tolerant of uncertainty and distress, and less defensive when they experience uncertainty (Kashdan et al., 2013; Silvia, 2005), we found that daily curiosity was a significant moderator of day's stress' association with depressed mood. More

specifically, on days when curiosity was higher than usual, the association between day's stress and depressed mood was attenuated. Day's curiosity moderated affective reactivity to stress but it was not associated with affective recovery, suggesting that participants high in flourishing have additional resources that allow them to respond to increases in daily stress in a manner that in turn allows them to avoid persistent depressed mood following daily stress experiences. These findings are consistent with prior research showing that mindfulness, often defined in terms of curiosity about the present moment (Bishop et al., 2004; Langer, 1989), attenuates reactivity to stress (Britton et al., 2012; Hoge et al., 2013). Our operationalization of curiosity also parallels research on reappraisal (Gunayden et al., 2016; Jamieson et al., 2013); on days that participants were able to take a step back and see their problems as opportunities to grow and learn, they experienced fewer negative consequences in the face of stressors. In the longer term, this may have physiological and health benefits, as past research has shown that appraising stressors as challenges (vs. threats) is associated with more adaptive response (Blascovich et al., 1999; Jamieson et al., 2012).

In order to ascertain long term effects of affective response to stress, we additionally examined prospective associations between affective reactivity and recovery in response to daily stress and flourishing over a 3-month period. Increased affective reactivity and decreased recovery in response to daily stress have been associated with health and well-being across substantial periods of time (Charles et al., 2013; Leger et al., 2018). We extend these findings to flourishing and find that increased affective reactivity was associated with decreases in flourishing over a three month period. Thus, although the depressed mood of people high in flourishing is less affected by increases in daily stress relative to people low in flourishing, over time, persistent negative emotional responses to stress lead to decreases in flourishing over time. We observed no

association between affective recovery at baseline and change in flourishing across three months. The association between affective reactivity and the absence of an association between affective recovery and change in flourishing over time encourage further consideration of the timescale at which the observed, likely bidirectional, associations between flourishing and affective reactivity and recovery may play out.

Limitations and Future Outlook

The findings should be interpreted in light of the study's strengths and limitations. The use of daily diary data allowed us to capture fluctuations in depression, stress, and curiosity during "life as it is lived" (Bolger, 2003). However, daily diary data are limited in their ability to test causal associations. The availability of longitudinal data is a strength of the study but the short period between the baseline and follow-up surveys (3-months) is a limitation. The finding of an association between affective reactivity and change in flourishing at this short timescale may be an indication that there may be substantial long-lasting effects of stress reactivity on flourishing. However, it is also possible that the potential effects of affective reactivity on flourishing are short-lived and would dissipate over a longer time span. Future work will benefit from longitudinal data spanning longer time periods to assess these two possibilities.

Conclusions

In summary, we extend understanding of the daily lives of individuals who flourish. We find that flourishing is associated with attenuated affective reactivity and quicker affective mood recovery to increases in daily stress. By examining curiosity's association with flourishing and showing that states of curiosity are associated with diminished affective reactivity in response to daily stress, we begin the task of identifying cognitive resources that serve to buffer against eve-

ryday distress. We also add to a body of findings suggesting that, although often minor and mundane, the stressors encountered in daily life prospectively undermine well-being, in this case flourishing, when they are accompanied by increases in depressed mood.

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Table 1

Correlations and Descriptive Statistics.

Variables	1	2	3	4	5	6	7	8	9
1. Flourishing	-								
2. Flourishing 3 Months	0.80*	-							
3. Change in Flourishing	-0.19*	0.44*	-						
4. Curiosity^a	0.25*	0.23*	0.02	-					
5. Depressed mood^a	-0.32*	-0.46*	-0.27*	0.03	-				
6. Stress^a	-0.22*	-0.34*	-0.22*	0.04	0.65*	-			
7. Affective Reactivity	-0.20*	-0.29*	-0.17*	-0.07	0.62*	0.15	-		
8. Affective Recovery	-0.11	-0.07	0.05	0.06	-0.10	-0.01	-0.38*	-	
9. Age	-0.07	-0.06	0.01	0.05	0.00	-0.09	0.07	-0.04	-
Variables									
<i>Mean</i>	5.92	5.91	-0.01	3.09	1.25	2.67	0.00	0.00	25.37
<i>Standard Deviation</i>	0.80	0.88	0.54	1.86	1.30	1.71	0.17	0.03	7.34

Notes: ^aIntraindividual mean of the daily diary time series. $N=167$, except for variables 2 and 3 where $N=164$. * $p<0.05$.

Table 2.

Results of the multilevel model examining flourishing's moderating effect on the association between stress and depressed mood.

Fixed Effects			
	<i>Estimate</i>	<i>Standard Error</i>	<i>p-value</i>
Intercept (γ_{00})	1.18***	0.08	<0.001
Day's stress (γ_{10})	0.28***	0.02	<0.001
Previous day's stress (γ_{20})	0.0003	0.01	0.98
Day of study (γ_{30})	0.01	0.004	0.21
Flourishing (γ_{01})	-0.28*	0.10	0.01
Usual stress (γ_{02})	0.44***	0.04	<0.001
Age (γ_{03})	0.004	0.01	0.67
Gender male (γ_{04})	0.30	0.18	0.11
Gender other (γ_{05})	1.16	0.61	0.06
Flourishing X day's stress (γ_{11})	-0.06*	0.03	0.04
Flourishing x previous day's stress (γ_{21})	-0.04*	0.02	0.03
Fit Indices			
AIC	9527.02		
BIC	9640.82		

Notes: $N = 2961$ days nested within 167 participants. Age and flourishing were sample-mean centered. Female was the reference category for gender.

Table 3.

Results of the multilevel model examining curiosity's moderating effect on the association between stress and depressed mood.

Fixed Effects			
	<i>Estimate</i>	<i>Standard Error</i>	<i>p-value</i>
Intercept (γ_{00})	1.15***	0.08	<0.001
Day's stress (γ_{10})	0.24***	0.02	<0.001
Previous day's stress (γ_{20})	0.004	0.01	0.76
Day's curiosity (γ_{30})	-0.10***	0.02	<0.001
Day of study (γ_{40})	0.005	0.004	0.27
Usual stress (γ_{01})	0.44***	0.04	<0.001
Usual curiosity (γ_{02})	0.03	0.04	0.44
Age (γ_{03})	0.01	0.01	0.26
Gender male (γ_{04})	0.36*	0.17	0.04
Gender other (γ_{05})	1.35*	0.59	0.02
Day's curiosity X day's stress (γ_{50})	-0.04***	0.01	<0.001
Fit Indices			
AIC	9428.60		
BIC	9566.36		

Notes: $N = 2961$ days nested within 167 participants. Age was sample-mean centered. Female was the reference category for gender.

Table 4.

Results of the multiple regression examining associations between change in flourishing and affective reactivity and recovery.

Change in flourishing			
	<i>Estimate</i>	<i>Standard Error</i>	<i>p-value</i>
Intercept	-0.02	0.05	0.65
Affective reactivity	-0.55*	0.27	0.04
Affective recovery	-0.43	1.47	0.77
Age	0.001	0.01	0.82
Gender male	0.04	0.11	0.75
Gender other	0.10	0.39	0.81
<i>R</i>²	0.03		
<i>F</i>	0.95		

Notes: Age was sample-mean centered. Female was the reference category for gender. *N*=164.

Figure 1.

Figure 1. Results of analyses examining associations between flourishing, curiosity, and affective reactivity and recovery. (A) Days of higher than usual stress (x-axis; 0 indicates a day of usual stress) are associated with relatively high depressed mood (y-axis) and the association is attenuated at high values of flourishing. **(B)** Depressed mood (y-axis) is high following days of higher than usual stress (x-axis; 0 indicates a day of usual stress) in participants low in flourishing. No association emerges between previous day's stress and depressed mood in participants high in flourishing. **(C)** Days of higher than usual stress (x-axis; 0 indicates a day of usual stress) are associated with high depressed mood (y-axis), but only on days of low curiosity. **(D)** Greater depressed mood reactivity (x-axis) is associated with greater decreases in flourishing (y-axis) across 3 months. *** $p<0.001$; * $p<0.05$.