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Benefit finding and diurnal cortisol slope in maternal caregivers: A moderating role for positive emotion

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Summary
The purpose of the present study was to explore the associations among benefit finding, daily positive and negative emotion, and daily cortisol slope in 71 maternal caregivers. Benefit finding was measured using the Posttraumatic Growth Inventory (PTGI; Tedeschi, R. G., & Calhoun, L. G. (1996). The Posttraumatic Growth Inventory: Measuring the positive legacy of trauma. Journal of Traumatic Stress, 9, 455–472.). Cortisol slope was not significantly correlated with any of the PTGI subscales, positive emotion, or negative emotion. However, the interactions of daily positive emotion with the PTGI subscales of Personal Strength, Appreciation of Life, and Spiritual Change were statistically significant such that higher scores on these subscales predicted a steeper (more adaptive) daily cortisol slope only for those women who also had higher levels of daily positive emotion.

Keywords: Posttraumatic growth; stress related growth; positive emotion; diurnal cortisol

Introduction
A deeper appreciation of life, improved personal relationships, deeper spirituality, greater clarity in priorities, and increased confidence in one's abilities are not obvious consequences of an extremely stressful experience. However, for a significant number of people, in addition to negative sequelae, the experience of severe stressful events can have positive consequences as well. For the purposes of the present article, we will refer to these positive personal changes in the wake of a traumatic or stressful event as benefit finding (Tennen & Affleck, 2002) although the concept has been studied under a number of names including posttraumatic growth (Tedeschi & Calhoun, 1996), stress related growth (Park, Cohen, & Murch, 1996), adversarial growth (Linley & Joseph, 2004), and thriving (Abraido-Lanza, Guier, & Colon, 1998; Epel, Mcewen, & Ickovics, 1998).

Although the findings are not entirely consistent (for a review, see Park, 1998), studies of the prospective link between benefit finding and subsequent adjustment generally indicate that perceptions of benefit predict better affective outcomes longitudinally (Affleck & Tennen, 1991; Davis, Nolen-Hoeksema, & Larson, 1998; Park & Fenster, 2004; Sears, Stanton, & Danoff-Burg, 2003; Tennen, Affleck, Urrows, Higgins, & Mendola, 1992). For example, in a sample of participants with rheumatoid arthritis, perception of benefits from having to live with chronic pain were prospectively associated with more daily positive mood (less depression, anxiety, and hostility, more elation, composure, and agreeableness; Tennen et al., 1992). Davis, Nolen-Hoeksema, and Larson (1998) found that bereaved individuals who perceived something positive in the experience of the death of a loved one at 6 months post loss had lower levels of distress at 13 and 18 months post loss.

In addition to the generally positive psychological effects of benefit finding, individuals who find benefit in a stressful experience are also at lower risk of subsequent physical health problems (Affleck, Tennen, Croog, & Levine, 1987; Bower, Kemeny, Taylor, & Fahey, 1998; Linley & Joseph, 2004; Sears et al., 2003). For example, Affleck et al. (1987) found that perception of benefits such as changes in relationships or increased likelihood of healthy behaviors from an initial heart attack was associated with a lower likelihood of a subsequent heart attack. Bower et al. (1998) found that perception of positive sequelae after the death of a loved one from AIDS was associated with a less rapid decline in
CD4 cells and a lower likelihood of mortality in a sample of men with HIV. Interventions designed to increase perceptions of benefits after a stressor in a variety of ill and healthy samples indicate that increases in finding benefit are associated with reduced morbidity (Stanton et al., 2002), fewer medical visits (King & Miner, 2000), and improvements in immune functioning (Bower, Kemeny, Taylor, & Fahey, 2003; McGregor, Antoni, Boyers, Alferi, Blomberg, & Carver, 2004).

The primary stress response system, the hypothalamic pituitary adrenal (HPA) axis, and cortisol in particular, has been a focus in the exploration of the link between benefit finding and physical health (Cruess et al., 2000; Epel et al., 1998). Cortisol is released in response to acute stressors, but is also released in a predictable pattern throughout the day, with the highest levels in the morning, which often peak shortly after waking, and a steady decline until evening. This pattern is normative, seen in most healthy young people (Stone et al., 2001; Weitzman et al., 1971). However, chronic or repeated stress can lead to alternations in daily cortisol secretion, such as chronically elevated levels, or a flatter diurnal rhythm. These patterns can have deleterious physical effects (Abercrombie et al., 2004; Bower, Ganz, Dickerson, Petersen, Aziz, & Fahey, 2005; McEwan, 1998; Sephton, Sapolsky, Kraemer, & Spiegel, 2000). Perceptions of benefit in the wake of a stressful event may serve to buffer the effects of chronic or severe stress, and thus serve to reduce basal or reactive levels and maintain healthy daily cortisol rhythms. Epel, McEwan, and Ickovics (1998) found that women who reported greater benefit finding (increases in appreciation of life and spiritual growth, two subscales of the posttraumatic growth inventory; Tedeschi & Calhoun, 1996) in response to the most stressful event of their adult lives, had a more rapid cortisol adaptation to a repeated laboratory stressor than women who reported less benefit finding. Cruess et al. (2000) found increases in benefit finding from having breast cancer (e.g., “breast cancer has led me to be more accepting of things” or “has helped me become more focused on priorities, with a deeper sense of purpose in life”) were associated with lower levels of serum cortisol in a sample of women undergoing treatment.

How might perceptions of benefit lead to healthier HPA axis functioning? The possibility that positive emotion serves as a key mediator is suggested by the work of Fredrickson, Tugade, and colleagues on the association of the personality trait of resilience with physiological and psychological responses to laboratory and naturalistic stressors (Fredrickson, Tugade, Waugh, & Larkin, 2003; Tugade & Fredrickson, 2004). Resilience is a stable personality trait characterized by the ability to successfully adapt in the face of adverse circumstances, and individuals who are high on trait resilience are, in theory, more likely to perceive benefits in the wake of a serious stressor (Almedom, 2005; Tedeschi & Calhoun, 1995, 2004). Fredrickson and Tugade have demonstrated that positive emotions are key in the association between resilience and adaptive psychological and physical outcomes. Specifically, the associations of trait resilience with more rapid physiological recovery after negative emotional arousal (Tugade & Fredrickson, 2004), finding positive meaning in a stressful event (Tugade & Fredrickson, 2004), and lower levels of depression following the September 11 terrorist attacks (Fredrickson et al., 2003) were all mediated by positive emotion.

Positive emotion is uniquely associated with lower risk of mortality and morbidity in a number of healthy and chronically ill samples (Danner, Snowdon, & Friesen, 2001; Kawamoto & Doi, 2002; Levy, Lee, Bagley, & Lippman, 1988; Moskowitz, 2003; Ostir, Markides, Black, & Goodwin, 2000; Pressman & Cohen, in press). Positive emotion is also associated with lower total levels of cortisol (Cohen, Doyle, Turner, Alper, & Skoner, 2003; Lindfors & Lundberg, 2002; Smyth et al., 1998; Steptoe, Wardle, & Marmot, 2005). However, some findings indicate that positive emotion is not predictive of diurnal rhythm (Smyth et al., 1997) or is associated with a flattened diurnal cortisol rhythm (Lindfors & Lundberg, 2002; Polk, Cohen, Doyle, Skoner, & Kirschbaum, 2005), a pattern that is generally associated with negative health consequences (Abercrombie et al., 2004; Bower et al., 2005; Sephton et al., 2000; Stone et al., 2001).

In the small but growing literature on prospective correlates of benefit finding, researchers are beginning to explore the contextual modifiers of the effects of benefit finding by testing statistical interactions of benefit finding and other relevant variables on the outcomes of interest (Sears et al., 2003; Tennen et al., 1992). For example, Tennen et al. (1992) found that daily pain moderated the association between benefit finding and daily activity limitation such that benefit finding was more strongly associated with reduced limitation for those who had more severe pain. In a sample of women recovering from breast cancer, Sears et al. (2003) found that coping through finding benefit was associated with higher levels of positive mood a year later, particularly for those who had lower positive mood initially. Tennen et al. (1992) note that the benefit finding literature “has been based on main effects with potential moderator effects either going unreported or more likely, untested. One reason for this neglect is that most investigations have been cross sectional; the interaction of benefits with subsequent outcomes could not be assessed” (p. 199). The longitudinal
In the present study, we examined the association of finding benefit from participant’s most stressful life event with subsequent daily cortisol, positive emotion, and negative emotion in a sample of maternal caregivers of chronically ill or healthy children. We hypothesized that perception of benefits would be associated with more positive emotion, less negative emotion, lower mean cortisol, and a more adaptive diurnal rhythm (i.e., steeper negative slope) of cortisol. Furthermore, based on the work of Fredrickson and Tugade (Fredrickson et al., 2003; Tugade & Fredrickson, 2004), we explored the possible mediational role of daily positive emotion in the association between finding benefit and cortisol outcomes. Given the call for work on potential modifiers of the effects of perceptions of benefit (Tennen et al., 1992), we explored three possible modifiers of the association between perceptions of benefit and daily cortisol. Specifically, we explored the possibility that perceptions of benefit interact with (a) daily positive or negative emotion, (b) chronic stress status (caregiver vs. control), or (c) the chronic nature of the stressor that led to benefit perceptions, to predict daily cortisol.

Method
Participants

Participants were 71 women who were currently providing care for a chronically ill child \( n = 45 \) or a healthy child \( n = 26 \). Participants were biological mothers who were the primary caregivers in the home. Some of the participants were recruited as part of a larger study exploring stress, coping, and psychological adaptation of maternal caregivers (Heyman et al., 2004; Wilson et al., 2005). Additional participants were recruited from general and specialty pediatric clinics in the San Francisco Bay area or by public postings. The study was described over the telephone, and the participants were screened for eligibility. Eligibility criteria included still having menstrual periods, having no current chronic illness, and taking no medications known to affect the HPA axis. Exceptions were made for controlled hypertension, medicated hypothyroidism, and antidepressant use \( n = 5 \). If eligible and interested, the participants came to the Oakland Children’s Hospital Pediatric Clinical Research Center and provided written informed consent. All procedures were approved by the UCSF and Children’s Hospital Committees on Human Research.

The participants’ mean age was 38, ranging from 19 to 51. The average years of education was almost 15 (range from 11 to 20). Sixty-one percent of the participants were White, 14% were African American, 11% were Asian and 10% were Latina. Forty-five (63%) of the participants were caring for a chronically ill child. The chronically ill children had a range of illnesses, including developmental (autism), gastrointestinal, and neurological (cerebral palsy) disorders.

Procedures

The study consisted of a baseline psychosocial questionnaire and physical health assessment followed by home daily saliva sampling completed within the following week. All sessions took place during the first 7 days of the follicular stage of the menstrual cycle, when sex hormones are the lowest. Participants were given a saliva sampling kit with plastic saliva collection containers for the home saliva sampling. The research assistant trained them in the saliva sampling procedure and each participant practiced while at the Research Center. Participants took saliva samples 3 times a day for 2 days: upon waking, 30 minutes after waking, and at bedtime. Samples were stored in the freezer soon after each collection. Participants were reminded not to eat, drink, or brush their teeth for 15 minutes prior to any saliva sampling. Women also reported concurrent emotion at the time of saliva sampling. At the end of each sampling day, participants reported their health behaviors for the day (e.g., smoking, exercise). Participants returned samples and mood diaries or had a courier retrieve them shortly after the collection ended, using coolers to keep samples frozen until they were assayed.

Measures

Demographics and other descriptive information. Participants reported their age, race/ethnicity, and number of years of education. In addition, if the participant was the caregiver of a chronically ill child, she was asked for the child’s primary diagnosis.

Benefit finding. Participants were asked to briefly write down the most stressful event of their adult lives, then to fill out the Post Traumatic Growth Inventory (PTGI; Tedeschi & Calhoun, 1996) to indicate perceived positive sequelae of the stressful event. The response scale for each item ranged from 1 = “I did not experience this change as a result of my crisis” to 6 = “I experienced this change to a very great degree as a result of my crisis.” The PTGI consists of five subscales: relating to others (e.g., “I learned a great deal about how wonderful people are”), new possibilities (e.g., “I established a new
path for my life.'"), personal strength (e.g., "I discovered that I'm stronger than I thought I was"), spiritual change (e.g., "I have a stronger religious faith"), and appreciation of life (e.g., "An appreciation for the value of my own life"). We computed total PTGI and the five subscale scores by summing component items. Given empirical (Epel et al., 1998) and theoretical (Calhoun & Tedeschi, 2004; Janoff-Bulman, 2004) evidence that the subscale scores may differentially relate to outcomes, we examined the five factors of the PTGI separately.

The extent to which a participant reports benefits as a result of a stressful event may differ depending on whether the event is ongoing or has ended. In order to address this question, we classified the events participants listed as the most stressful or traumatic in their lives as chronic/ongoing (i.e., the child's chronic illness) or acute (an event that had occurred in the past that was now over). Two experienced qualitative analysts independently classified the events and agreed on 64 of the 65 events (four participants filled out the PTGI without listing events; two participants did not fill out the PTGI). The one discrepancy was resolved through discussion.

**Emotion.** Positive and negative emotion were each measured at each saliva sampling with a single item in the diary: for positive emotion "How happy, excited, or content do you feel right now?" and for negative emotion "How sad, anxious, or angry do you feel right now?" The response scales range from 0 = "not at all" to 3 = "extremely." For the analyses we calculated the mean positive and mean negative emotion reports by averaging across the six emotion reports for each (3 times per day x 2 days).\(^1\)

**Daily health behaviors.** At the end of each saliva sampling day, participants were asked to record in the daily diary if they had used tobacco that day and, if so, how many cigarettes or other tobacco products they had used; how many alcoholic drinks they had consumed; how many minutes of vigorous exercise they had engaged in; and what time they had fallen asleep the previous night and what time they had awakened that day (to calculate number of hours of sleep the previous night).

**Salivary cortisol.** Although some investigators perform a log transformation on the raw cortisol values to achieve a more normal distribution (e.g., Sephton et al., 2000; Stone et al., 2001), in the present study the distribution of cortisol values was judged sufficiently normal that we used raw values (as did Carlson, Speca, Patel, & Goodey, 2003; Steptoe et al., 2005). Mean cortisol was calculated by averaging the six cortisol samples from the two sampling days. Cortisol slope was calculated as a difference between the first and last sampling for each day, omitting the waking + 30 value as suggested by Kraemer et al. (in press). The two difference scores were then averaged across the two sampling days.

**Results**

Participants filled out the PTGI in response to the most stressful or traumatic event of their adult lives. The majority (57%) of the participants reported their child's illness or something else associated with their child as the most stressful or traumatic event. Other stressful events reported in both groups included divorce and death of a loved one. Twenty-seven of the events were classified as ongoing, 38 were classified as over.

Caregivers of chronically ill children had, not surprisingly, significantly lower positive emotion (\(t(69) = -2.37, p = 0.02\)) and significantly higher negative emotion (\(t(69) = 4.59, p < 0.001\)) than caregivers of healthy children. Also consistent with the nature of our sample, caregivers of ill children were more likely than caregivers of healthy children to report an ongoing stressor as their target event for the PTGI (\(\chi^2(1) = 17.28, p < 0.001\)). The two caregiving groups did not differ, however, on total score or subscales on PTGI, cortisol slope, or mean cortisol. Means and standard deviations for all variables by caregiver group appear in Table I. The means on the PTGI are comparable to those reported elsewhere in the literature (Linley & Joseph, 2004; Stanton, Bower, & Low, in press), and the internal consistency was acceptable for all the subscales.

Correlations among the PTGI subscales, positive and negative emotion, cortisol slope, and mean cortisol appear in Table II. Four of the five PTGI subscales correlated significantly with daily positive emotion, but none were significantly associated with daily negative emotion. The PTGI subscales, daily positive emotion, and daily negative emotion were unrelated to mean cortisol or cortisol slope. None of the health behaviors was significantly correlated with mean cortisol or cortisol slope and the ongoing vs. acute nature of the target event for the PTGI was not significantly associated with positive or negative emotion, mean cortisol, cortisol slope, or any of the PTGI subscales.

We next performed a series of regressions to predict total cortisol and cortisol slope. Given the lack of significant bivariate associations of PTGI or positive emotion with the cortisol outcomes, we did not pursue mediational analyses (Baron & Kenny, 1986). Thus, our hypothesis that positive emotion would mediate an association between
perception of benefit and daily cortisol was not supported. We did, however, explore the potential moderating role of positive emotion, negative emotion, caregiver group, and the chronic vs. acute nature of the target event for the PTGI. For the total PTGI and each subscale, we simultaneously entered the subscale, the potential moderator (positive emotion, negative emotion, caregiver group, chronic or acute event), and their interaction as predictors of either cortisol slope or total cortisol. All independent variables were centered prior to running the regressions testing interactions (Aiken & West, 1991).

None of the interactions predicting total cortisol was significant. For cortisol slope, the only significant interactions included positive emotion. Specifically, the interactions between positive emotion and the PTGI subscales of personal strength, appreciation of life, and spiritual change, were statistically significant such that higher scores on these subscales predicted a steeper (more adaptive) cortisol slope only for those women who also had higher levels of positive emotion. Results of the regressions predicting average daily cortisol slope from each PTGI subscale, daily positive emotion, and their interactions appear in Table III.

It is possible that positive emotion is important only because it related to lower negative emotion so we tested whether the effect of positive emotion was significant over and above any effect of negative emotion. However, adding negative emotion into the models did not change the statistical significance of any of the predictors or the interactions and negative emotion was not a significant predictor of the cortisol outcomes.

### Table I. Means (standard deviations) for the total sample and separately for caregivers of chronically ill and caregivers of healthy children for all study variables.

<table>
<thead>
<tr>
<th></th>
<th>Total sample</th>
<th>Caregivers of chronically ill children</th>
<th>Caregivers of healthy children</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTGI total (α = 0.93)</td>
<td>61 (22.9)</td>
<td>60.04 (20.66)</td>
<td>62.76 (26.83)</td>
</tr>
<tr>
<td>New possibilities (5 items; α = 0.84)</td>
<td>13 (6.5)</td>
<td>12.67 (6.48)</td>
<td>13.39 (7.44)</td>
</tr>
<tr>
<td>Relating to others (7 items; α = 0.84)</td>
<td>19.6 (8.4)</td>
<td>19.11 (7.20)</td>
<td>20.32 (9.52)</td>
</tr>
<tr>
<td>Personal strength (4 items; α = 0.73)</td>
<td>12.8 (4.8)</td>
<td>12.62 (4.36)</td>
<td>13.28 (5.32)</td>
</tr>
<tr>
<td>Appreciation of life (3 items; α = 0.80)</td>
<td>10.5 (3.9)</td>
<td>10.49 (3.51)</td>
<td>10.48 (4.64)</td>
</tr>
<tr>
<td>Spiritual change (2 items; α = 0.86)</td>
<td>5.2 (3.8)</td>
<td>5.16 (3.75)</td>
<td>5.44 (3.74)</td>
</tr>
<tr>
<td>Positive emotion*</td>
<td>1.07 (0.51)</td>
<td>0.964 (0.436)</td>
<td>1.25 (0.577)</td>
</tr>
<tr>
<td>Negative emotion***</td>
<td>0.48 (0.50)</td>
<td>0.651 (0.529)</td>
<td>0.204 (0.290)</td>
</tr>
<tr>
<td>Mean cortisol</td>
<td>11.32 (5.20)</td>
<td>11.23 (5.4)</td>
<td>11.49 (4.9)</td>
</tr>
<tr>
<td>Cortisol slope (change)</td>
<td>−11.49 (8.01)</td>
<td>−11.13 (7.69)</td>
<td>−12.12 (8.64)</td>
</tr>
</tbody>
</table>

*Caregivers of chronically ill children vs. caregivers of healthy children p < 0.05.  
***p < 0.001.

### Table II. Bivariate correlations of subscales of PTGI, with daily positive and negative emotion, mean cortisol, and cortisol slope.

<table>
<thead>
<tr>
<th></th>
<th>New possibilities</th>
<th>Relating to others</th>
<th>Personal strength</th>
<th>Appreciation of life</th>
<th>Spiritual change</th>
<th>Positive emotion</th>
<th>Negative emotion</th>
<th>Mean cortisol</th>
<th>Cortisol slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relating to others</td>
<td>0.651**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal strength</td>
<td>0.678**</td>
<td>0.723**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appreciation of life</td>
<td>0.493**</td>
<td>0.763**</td>
<td>0.669**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spiritual change</td>
<td>0.487**</td>
<td>0.601**</td>
<td>0.367**</td>
<td>0.505**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive emotion</td>
<td>0.195</td>
<td>0.365**</td>
<td>0.263*</td>
<td>0.280*</td>
<td>0.355**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative emotion</td>
<td>0.053</td>
<td>0.069</td>
<td>0.060</td>
<td>0.080</td>
<td>0.136</td>
<td>−0.206†</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean cortisol</td>
<td>−0.017</td>
<td>0.028</td>
<td>−0.024</td>
<td>0.028</td>
<td>0.073</td>
<td>−0.075</td>
<td>−0.041</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cortisol slope</td>
<td>0.074</td>
<td>−0.097</td>
<td>0.049</td>
<td>0.001</td>
<td>0.044</td>
<td>0.106</td>
<td>0.086</td>
<td>−0.548**</td>
<td></td>
</tr>
</tbody>
</table>

†p < 0.10; *p < 0.05; **p < 0.01.

### Table III. Summary of regression models predicting cortisol slope from PTGI subscales and positive emotion.

<table>
<thead>
<tr>
<th></th>
<th>New possibilities (β)</th>
<th>Relating to others (β)</th>
<th>Personal strength (β)</th>
<th>Appreciation of life (β)</th>
<th>Spiritual change (β)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTGI subscale</td>
<td>0.053</td>
<td>−0.098</td>
<td>0.028</td>
<td>−0.060</td>
<td>0.004</td>
</tr>
<tr>
<td>Daily positive emotion</td>
<td>0.090</td>
<td>0.129</td>
<td>0.118</td>
<td>0.003</td>
<td>0.128</td>
</tr>
<tr>
<td>Subscale × positive emotion interaction</td>
<td>0.026</td>
<td>−0.194</td>
<td>−0.378**</td>
<td>−0.377**</td>
<td>−0.307*</td>
</tr>
</tbody>
</table>

*p < 0.05; **p < 0.01.
Finally, we tested several three-way interactions to determine whether the interaction of positive emotion and PTGI subscales was equally predictive of cortisol slope for caregivers and controls, for ongoing vs. acute situations, and for those high and low in negative emotion. Specifically the interactions we tested were positive emotion × PTGI subscale × caregiving group; positive emotion × PTGI subscale × ongoing/acute situation; and positive emotion × PTGI subscale × negative emotion. None of the three-way interactions reached statistical significance.

Discussion

Our results demonstrate that perceptions of benefit from a stressful or traumatic life event predict a more adaptive daily cortisol pattern, but only for those individuals who report higher daily positive emotion as well. Although four of the five subscales of the PTGI were significantly correlated with subsequent daily positive emotion, neither the subscales nor positive emotion alone had significant direct effects on diurnal cortisol. Thus, the mediational hypothesis that perception of benefits may function like trait resiliency to increase positive emotion, which in turn is associated with improved health outcomes, was not supported by our data. Our data suggest that perceptions of benefit are not uniformly physically advantageous for everyone, at least in terms of daily cortisol. Rather, it may be that there is a subgroup of women who are able to capitalize on perceptions of benefit and draw on them in their daily lives in such a way that increases their positive emotion and results in a healthier diurnal cortisol profile. Perhaps it is not enough simply to report benefits. Instead one must experience and act on those benefits (akin to Affleck & Tennen’s 1996, concept of “benefit reminding”) on a daily basis for positive physiological outcomes to accrue. Alternatively, for some, benefit finding may represent deeper changes in appraisal schemas, that implicitly or consciously promote less threat appraisals and greater experience of positive emotions in response to daily stimuli. Future studies should examine how perceptions of benefit are carried out in the daily lives of individuals living in the aftermath of extremely stressful or traumatic events.

Another way to view the present results, given that positive emotion alone was not a significant predictor of diurnal cortisol, is that positive emotion is only related to cortisol slope in those for whom the positive emotion holds some deeper significance or meaning. Perhaps those for whom positive emotion is based on or drawn from the perceptions of an enriched life in the wake of a stressful event are those most likely to experience more advantageous physiological outcomes. It may be that all positive emotion is not uniformly influential in terms of physical health. Rather, it is positive emotion that stems from personally valued beliefs and goals that has the greatest health impact (Moskowitz, Wrubel, Acree, & Folkman, 2001). In any event, the fact that the significant bivariate and multivariate effects were exclusively with positive, but not negative, emotion adds to the rapidly growing literature indicating that positive and negative affective predictors and outcomes need to be examined separately, not as bipolar ends of a single affective continuum (e.g., Folkman & Moskowitz, 2000; Fredrickson, 1998; Lyubomirsky, King, & Diener, in press).

One of the advantages of the PTGI is that it has subscales which allows differential effects of the different aspects of benefit finding to be uncovered. The subscales of personal strength, increased appreciation of life, and spiritual change had particularly robust effects that remained statistically significant even when negative emotion was included in the models. Why might these subscales be particularly relevant for HPA axis function? The personal strength subscale includes perceptions of change in areas such as “a feeling of self-reliance,” “knowing I can handle difficulties,” and “being able to accept the way things work out.” Appreciation for life includes items such as “My priorities about what is important in life,” and “appreciating each day.” Spiritual change includes items such as “I have a stronger religious faith.” These three subscales appear to be particularly relevant to supporting adaptive coping with stress on a daily basis and thus may be more strongly related to the daily stress response as reflected in the diurnal cortisol rhythm. Consistent with these findings, two of these same subscales (appreciation for life and spiritual growth) were also predictive of more rapid cortisol habituation to repeated stress in Epel et al. (1998). Researchers have recently called for closer examination of the differential predictors and consequences of the subscales of the PTGI (Calhoun & Tedeschi, 2004). Our results suggesting that four of the five subscales were associated with positive emotion and that three of the five interacted with positive emotion to predict daily cortisol slope support this more fine-grained examination of different aspects of benefit finding.

Previous studies have failed to find an association between positive emotion and cortisol slope (Smyth et al., 1997) or found that positive emotion was associated with a flatter diurnal slope (Lindfors & Lundberg, 2002; Polk et al., 2005), a pattern generally found to be predictive of poorer health outcomes (Abercrombie et al., 2004; Bower et al., 2005; Sephton et al., 2000), although not in all cases (Smyth et al., 1997). Future work is needed to more...
A moderating role for positive emotion

precisely delineate the adaptive and maladaptive profiles with respect to diurnal cortisol rhythm by conducting longitudinal studies of the association of different cortisol patterns on physical health outcomes (Sephton et al., 2000; Bower et al., 1998). Other studies have found direct (unmoderated) effects of perceptions of benefit (e.g., Epel et al., 1998) or positive emotion (Cohen et al., 2003; Kugler & Kalveram, 1987; Polk et al., 2005) and various cortisol outcomes, whereas, in the present study, we did not find these direct associations. The different findings may be attributable to differences in the participants (healthy vs. chronically ill participants) or in method of measuring cortisol (e.g., urinary vs. serum vs. salivary). Again, future work should carefully consider these factors as possible influences of the study outcome.

While hypercortisolemia is related to clinical states (major depression, Alzheimer’s Disease; see Otte et al., 2005), subtle psychological processes in healthy samples may be more related to cortisol slope, which reflects central regulation of circadian rhythms. Our finding that cortisol slope, but not mean cortisol level, was associated with other study variables is not unique. Cohen and colleagues found that higher social status was related to steeper cortisol slope, but not to mean cortisol (Cohen et al., in press). Their effect was mainly due to lower evening cortisol, which tends to reflect efficient negative feedback to suppress nightly cortisol. Sephton et al. (2000) found that slope but not mean cortisol predicted survival time in a sample of women with breast cancer and Bower et al. (2005) found that fatigued breast cancer survivors had flatter cortisol slopes but did not differ from non fatigued survivors on mean cortisol levels or area under the curve (AUC).

Caveats. There are a number of ways in which the present study was not ideal. First we do not have information on how long ago the events occurred that the women were reporting as the most stressful or traumatic of their adult lives. There is some evidence that the passage of time increases perceptions of growth after a traumatic or stressful event (Cordova, Cunningham, Carlson, & Andrykowski, 2001; Park et al., 1996), and it may be that time since the event influences how likely any perceptions of benefit are to influence daily positive emotion and cortisol pattern. Our classification of whether the event was chronic (ongoing) or acute (had ended at some point in the past) was not associated with emotion, cortisol, or any of the PTGI subscales and did not change the nature of the interaction with positive emotion.

Second, we measured positive (and negative) emotions with a single item that combined both high activation (e.g., excited) and low activation (e.g., content) emotions. It is entirely possible that high activation emotions would be more strongly associated with cortisol than low activation emotions (see Pressman & Cohen, in press, for a discussion), and by combining them we may have masked some of the true association between emotion and cortisol. Beyond high and low activation, interpersonal emotions such as love and compassion may be particularly relevant for a caregiving sample such as the present one and the fact that our measure only tapped self-focused emotions may have diminished our ability to detect a role for positive emotion in the association of benefit finding and daily cortisol.

Third, we discuss the results as if positive emotion causes the cortisol slope but, given that we did not experimentally manipulate emotion, we cannot rule out the possibility that the reverse is true, namely that a steeper decline in cortisol over the course of the day indirectly influenced brain (limbic) structures that might promote higher levels of positive emotion (in participants with higher levels of perceived benefits). There are, however, a number of studies in which positive emotion was induced in the laboratory and resulted in changes in cortisol (e.g., Berk et al., 1989; Hubert & de Jong-Meyer, 1990). Our interpretation that positive emotion leads to changes in cortisol is consistent with these findings.

Finally, the results should be interpreted with caution given the number of statistical tests we conducted and the comparatively small sample size. Rather than adjusting our p values to account for the large number of tests, we followed a philosophy of interpreting results only when they exhibited a meaningful pattern. We did not have a priori hypotheses regarding the potential moderational role of positive emotion so replication of the study is certainly warranted before any definitive conclusions are drawn.

Future research directions. Our results suggest the possibility that not everyone who reports psychological benefits reaps subsequent physical benefits. This raises many questions. Are there some for whom perceived benefits are taken to heart, who subsequently make radical changes in their day-to-day lives? Are there others who simply play lip service to “growing” from the experience but who evidence no actual psychological or physical benefit? What differentiates these two groups? As suggested above, questions regarding the associations among perceptions of benefit, positive emotion, and physical health would be well served by taking future work in a number of directions. Future work should explore how perceptions of benefit in the wake of a major life stressor might influence an individual’s daily experience, such as by getting ecological momentary assessments of daily events, appraisals, coping, and emotion. It is crucial to identify the psychological
processes that promote positive emotion and resilience to stressors, to inform interventions for those most vulnerable to stress, depression, and negative health sequelae.

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Endnotes

1. Because of the timing of the emotion assessments, morning emotion may be over-emphasized by simply averaging all the assessments over the course of a day. To address this possibility, we also performed all analyses using the average of the morning and evening assessments (excluding the waking + 30). The results were essentially the same as those which included all three emotion assessments for each day.

2. We also calculated the 2 point slope (change score) of emotion over the course of the day then tested correlations of positive and negative emotion slope with the PTGI subscales and cortisol. With the exception of the correlation between positive emotion change and New Possibilities (r = -0.235, p = 0.052), none of the correlations were significant. In addition, the interactions of the 5 PTGI subscales with slope of positive emotion were not significant predictors of cortisol. These additional analyses are available from the first author.

References


