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16 The Dynamics of Emotion in Adaptation to Stress

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INTRODUCTION

What does it mean to say, "I'm stressed"? Early in the study of stress processes in humans, such a statement was thought to indicate that an individual had faced a physiological insult and was making efforts to return to what Cannon (1929) referred to as "homeostasis," or the body's state of balance (Goldstein & Kopin, 2007). The advent of Selye's (1956) concept of stress as any threat requiring some general adaptation had the ironic effect of both popularizing the notion of stress as a ubiquitous phenomenon and uniting many biomedical researchers in a common agenda to dismiss the idea of a generalized stress response altogether. Fortunately for the biobehavioral and social sciences, the stress construct proved to be resilient. There were too many empirical findings relating adverse events to physiological processes that could not be explained without reference to stress responses. However, with criticism came many refinements, including greater attention to identification of distinct responses to threat. Fast-forward to present-day and one can find an extensive literature identifying emotions as central organizing features in our response to stress. Throughout our lives, stress, in various forms, tests our adaptive capacity to regulate emotion and sustain well-being in the face of adversity. Importantly, as highlighted in the ensuing pages of this chapter, research has come to recognize emotions as both a reaction to a threat and an adaptive response that can help the individual maintain well-being and regain homeostasis despite systemic challenge.

The aim of this chapter is to explore the rich and growing body of literature on emotions as they relate to stress, to the health problems that result from failures in adaptation, and to resilient responses that promote positive adaptation. We begin by providing definitions of emotion and stress that allow researchers to make clear distinctions between these constructs. We then discuss evidence in support of a view that the relations between different emotions are dynamic and take on a particular importance in the face of stress. Finally, the chapter will discuss the various implications of emotion for health outcomes and how interventions may aid the individual in adaptation to emotionally charged events, whether illness-related stressors like pain or interpersonal difficulties such as marital conflict.

SOME USEFUL DEFINITIONS OF EMOTION AND STRESS

There are many ways to construe the properties of an emotion. We define emotion as a state comprising both a feeling (i.e., a sensation with a valence) and a motivation (i.e., an action tendency; Craig, 2003; Frijda, 1987) that drives behavior. Emotions are organized through a complex and highly specific series of neuronal pathways that facilitate the appraisal of environmental stimuli as well as of internal states of disequilibrium and allow for a designation of valence to the experienced emotion (LeDoux, 1998). Beginning in the periphery, the body can detect changes in autonomic nervous system activity and integrate that information into an emotional response that prepares the individual to approach or avoid a threat to homeostasis (Wiens, 2005). Reports of positive affect (PA) and negative affect (NA) provide direct evidence of underlying emotions. Both stable trait differences in level of emotion as well as emotional states formed in response to everyday events constitute forms of emotion.

As articulated by LeDoux (1998), emotions are the result of automatic processes governed by the brain and influenced by physiological feedback reflecting the current condition of the body relative to its homeostatic equilibrium. Top-down cognitive inputs can focus attention, augment the feeling, and shift the motivational component of automatically generated emotions (Schachter & Singer, 1962). Thus, the cognitive state of the organism at the time of emotional processing may determine the intensity and even the valence with which the emotion is expressed (Gross & Levenson, 1993). Emotions have been studied as adaptive responses to disturbances in equilibrium that can result in either maladaptive coping, in the case of depression, or adaptive coping, in the case of positive well-being (Schulkin, Thompson, & Rosen, 2003). In the tradition of William James (1884), current neurological research suggests a role for specific brain regions, such as the anterior insula and anterior cingulate cortex, in integrating information received from the body's periphery with the emotional experience (Wiens, 2005). The interoceptive process of receiving and interpreting bodily feedback informs the brain of a range of solutions that can be used to negotiate the challenge of a stressor (Adolphs, Damasio, Tranel, Cooper, & Damasio, 2000) and motivate an adaptive response.

When studying emotion processes, it is useful to adopt a definition of stress that is not confounded with emotion. Some stress researchers have given little attention to emotion, and many emotion researchers have ignored the role of stress in their formulations, in part because of the apparent overlap in the constructs. The approach that we adopt is to define stress as uncertainty introduced by unexpected events (Ursin & Olff, 1993; Zautra, 2003). This disturbance in expectancies upsets homeostasis, and the degree of upset varies considerably depending on the level of threat to current adjustment provoked by the disturbance. Some, but not all, emotions reflect responses to uncertainty and threat that arise from stressful events, but they are not the stress itself. Furthermore, uncertainty and threat do not constitute emotional states in themselves. By making these distinctions, we hope to encourage theory and research that address how stress and emotions interact dynamically to influence health and well-being.

MEASUREMENT AND INDUCTION OF EMOTION

The measurement of emotion, by itself, deserves an entire chapter. Here we provide only a glance at some of the dominant approaches, focusing on a dimensional model of affective space (discussions of conceptual and measurement issues related to discrete emotions may be found in Ekman, 1982; and Russell & Feldman Barrett, 1999). Watson and colleagues (Watson, Clark, & Tellegen, 1988; Watson & Tellegen, 1985; Watson, Weise, Vaidya, & Tellegen, 1999) proposed a two-dimensional model of emotion based on self-report data that consisted of both a PA dimension and a NA dimension. This work led to the development of the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988), through which 10 unique descriptors were found to load almost exclusively on a PA factor (e.g., attentive, excited, proud), whereas 10 others loaded on an NA factor (e.g., distressed, guilty, jittery). The result was a measure for stable characteristics of emotion that was internally consistent and reliably descriptive across different settings and over time (Watson & Clark, 1992). Importantly, the PANAS provided the field with a more reliable instrument than those that had previously been in use, such as Bradburn's (1969) NA and PA scales, and the scales of Stone and Hedges (Hedges, Jandorf, & Stone, 1985).

Since its introduction, this two-dimensional model of emotion has piqued the interest of personality researchers whose work concerned the overlap between personality traits and the affect systems. Tellegen (1985) introduced the link between personality and affect through the identification of "emotionality" dimensions. Positive emotionality refers to social aspects of well-being that are driven by extraversion and high positive activation. In contrast, negative emotionality refers to characteristics representative of neuroticism, such as anxiety and high stress-reactivity. The evidence for positive and negative emotionality traits supported earlier findings indicating that extraversion and neuroticism were correlated with PA and NA, respectively (Costa & McCrae, 1980).

A central question in the measurement of emotion is whether to treat the construct as a transient state reflective of direct environmental input or as a stable trait that predisposes individuals to make consistently similar appraisals of emotional stimuli. Although PA and NA do exhibit stability over time, Tellegen (1985) suggested that the personality dimensions of positive and negative emotionality may give rise to the experience of more transient PA and NA states. Thus, the high degree of correlation between personality traits and corresponding affects seems to reflect a confluence of both trait and state influences on emotional expression.

Russell and Feldman Barrett (1999) draw the distinction between core affect, which refers to basic elements of affective feelings, like pleasure versus displeasure, and prototypical emotional episodes, which refer to more complex and discrete emotions precipitated by some causal series of events. These authors note that discrete emotions included in the class of prototypical emotional episodes, such as anger, fear, and love, do not describe general states, but rather specific emotional categories that are experienced through a defined range of intensity (Russell & Feldman Barrett, 1999). Thus, a continuous scale of emotion intensity may be warranted even for the measurement of discrete emotions.

The two most commonly used methods for measuring emotion are single-occasion self-report and controlled laboratory measurement of reactivity to a stimulus. Single-occasion measurement is most effective when a researcher or clinician wishes to obtain a trait measure of emotion and does not have the luxury of repeated measurements or elaborate laboratory testing. The PANAS is a good example of a self-report instrument that can provide a window into an individual's general predisposition in appraising emotionally relevant stimuli. The extent to which this measure, and others like it, reflects state or trait characteristics of emotion depends on the temporal framing of the item stem. If individuals are asked to respond according to their feelings over the past hour, day, or even week, the interpretation may be different from that of a report in which individuals are asked to respond based on their general feelings over the past 6 months, for example.

Laboratory methods permit the induction of emotional states with a standard stimulus, providing greater experimental control at the possible loss of external validity. Examples of laboratory designs used to measure emotion include measurement of emotional state following painful stimuli (Zubieta et al., 2003), hedonic cueing with an addictive substance (Sayette et al., 2000), measurement of physiological markers such as electrodermal response (Brenner et al., 2005), reflexive eye blink (Lang, Bradley, & Cuthbert, 1990) following the presentation of emotionally evocative material, examination of facial expression of emotion (Ekman, 1982; Ekman & Oster, 1979), and presentation of video clips known to elicit emotional reactions (Davis, Zautra, Johnson, Murray, & Okvat 2007; Rottenberg, Kasch, Gross, & Gotlib, 2002). Integral to the laboratory design is the appropriate pairing of an aversive or pleasant stimulus with a measure of emotional reactivity that is capable of being altered.

One major problem facing emotion researchers accustomed to self-report data is the propensity of people to inaccurately recollect their past emotional experiences by relying on heuristics and general rules (Kahneman, 1999). Tennen (2006) found that the recollection of emotional states, such as sadness and guilt, was systematically biased by errors based on preexisting schemas. Researchers are increasingly turning to another method for measuring emotion, known as the daily process design, in an effort to avoid the pitfalls of retrospective reports. Through a daily diary format, participants are asked to report over a series of consecutive days on emotional experiences as they occur throughout each day, enabling researchers to estimate changes in within-person slopes over time in addition to aggregated interindividual differences (Tennen & Affleck, 2002). To increase compliance rates, time-stamped electronic diaries can ensure participant fidelity to study protocol. An additional methodological option is the experience sampling method, in which participants are randomly alerted to self-report at multiple points within each day (Csikszentmihalyi & Larson, 1992). The advantage of this design is that emotional states can be reported within close proximity to the events that may have precipitated them, allowing for an estimate of the immediate trajectory of the emotional response to and/or recovery from a pleasant or aversive event.

DYNAMICS OF EMOTION AND STRESS

There has been some controversy over the degree to which oppositely valenced affects are related within an affective, or evaluative, space (Cacioppo, Gardner, & Bernston, 1999), and part of that controversy stems from fundamentally distinct views of how the space is organized. Russell and Carroll (1999) support the notion that affect exists on a bipolar continuum whereby, heuristically speaking, a unit gain in one valence should be met with a unit loss in its opposite valence. One can imagine a simple straight line in which each pole represents the extreme high end of the range of PA and NA, respectively. In this framework, as an individual's NA increases, his or her PA should decrease, thereby increasing the degree of correlation between the two affects in a negative direction.

Another conceptualization of affective space considers PA and NA as separate, bivariate dimensions (Cacioppo et al., 1999). In this view, a net predisposition to approach or avoid a stimulus target may theoretically result from the dual processing of positive and negative affective components. To visualize an affective space that allows for affective differentiation, one can imagine a two-dimensional space with two perpendicular lines intersecting at a single point. One axis represents PA, and the other, NA. As an individual's NA increases in this model, his or her PA may or may not change, reflecting a degree of independence between the two affects (Zautra, 2003). In support of this model, the PA and NA scales of the PANAS (Watson et al., 1988) are substantially uncorrelated, suggesting that states of high positive affectivity do not necessitate concurrent states of low negative affectivity.

Although evidence has been offered for both the bivariate and bipolar models of affect (Reich, Zautra, & Davis, 2003), the integrative perspective of the Dynamic Model of Affect (DMA) perhaps comes closest to representing what happens in daily life. The DMA (Zautra, Potter, & Reich, 1997; Zautra, Smith, Affleck, & Tennen, 2001) recognizes the relative independence of affective components but holds that, during periods of elevated uncertainty/threat from stressful events, emotional states become less differentiated. Zautra, Berkhof, and Nicolson (2002) tested the hypothesis that stress would narrow the affective space between PA and NA in a sample of healthy workers in the Netherlands. They utilized an experience sampling method, a daily process design that randomly alerted people to obtain affect and event ratings 10 times per day for five consecutive days. Zautra and colleagues discovered that within-person estimates of the correlation between PA and NA were higher during moments when a stressful event was reported than during nonstress moments. In addition, a contingency analysis indicated that most individuals had a higher proportion of inverse PA/NA correlations under stressful than nonstressful moments, rebuffing earlier suggestions (e.g., Russell & Carroll, 1999) that psychometric and other statistical factors (e.g., changes in mean levels and variance of PA and NA under stress) were responsible for observed changes in the degree of relation between the two affects.

Why would we expect stress to impact the PA/NA relation? Stress has been shown to increase uncertainty, which in turn puts attentional demands on information processing circuits (Ursin & Olff, 1993). When one's information processing abilities are taxed, one's affective focus becomes limited and, consequently, PA and NA become more inversely correlated (Linville, 1985). During times of acute stress, this is an adaptive solution; the body must recruit energy to escape the most pertinent threat it faces. Thus, our affective complexity diminishes to minimize energy expenditure, escape threat, and regain homeostatic balance. Uncertainty facilitates this process by motivating the individual to cognitively attend to the emotion most closely tied to a stressor: NA.

The examination of affect in the context of the stress of episodic pain has provided another test of the DMA. According to the DMA, elevations in pain should be associated with a less affective differentiation, as patients must divert resources typically used for complex affective processing and instead employ them for other homeostatic regulatory purposes. In line with predictions derived from the DMA, Zautra et al. (2001) found that, during painful weeks, reduced levels of PA predicted heightened levels of NA in rheumatoid arthritis (RA) patients. Recent findings further suggest that elevations in pain were related to increases in NA and decreases in PA to a greater extent in fibromyalgia (FM) patients than in a control chronic pain group of osteoarthritis (OA) patients (Finan, Zautra, & Davis, 2009). Given prior evidence that pain uncertainty is more prevalent in FM patients, who have chronic widespread pain, than in OA patients, who have localized joint pain, these findings appear to be in line with predictions of the DMA.

Early criticism of approaches that incorporated a bivariate model of affective processing suggested that unmodeled individual differences could account for some of the findings that indicated separate dimensions for PA and NA (e.g., Russell & Carroll, 1999). Longitudinal naturalistic studies have tempered some of that criticism for several reasons. First, the calculation of within-person slopes allows for an examination of changes in the individual over time, irrespective of the data for sample peers. Second, repeated measurements over weeks, days, or even multiple times within a day provide a significant advantage in statistical power compared with cross-sectional designs. Finally, as mentioned earlier, measurements of stress, pain, and affect can be obtained exceptionally close to when events that influence such states actually occur. Future studies that make use of interactive voice response technology to collect data via cell phones or personal digital assistants multiple times within-day will likely lead the way in further advancing stress and emotion theory. In sum, there are several possible explanations for this "shrinkage" of affective space, including increased informational demands on emotion processing, regulation due to heightened uncertainty, and increased attention to resolution of NAs provoked by the disturbance of homeostasis. More work is needed to identify the underlying factors responsible for the observed effects of a significant increased inverse relationship between PA and NA following stressful events.

EMOTIONAL INTELLIGENCE AND STRESS

Investigators have also sought to identify individual differences in emotion regulation capacity. Emotional intelligence (EI) refers to an ability to process emotionally relevant information in the course of adaptation to environmental challenges (Mayer & Salovey, 1997; Gohm, Corser, & Dalsky, 2005). As we have shown in the current chapter, the maintenance of complex information processing abilities when presented with emotionally oriented stimuli is essential to successful adaptation in times of stress. A high level of EI requires not only the ability to reason cognitively about emotions but also an ability to access emotions at appropriate moments and regulate emotions in an effort to maintain an emotional homeostasis. Mayer and Salovey (1997) have divided the abilities represented by EI into four major categories: (1) awareness of emotional states in oneself and others; (2) use of feelings and other emotion data to facilitate decision making; (3) learning and retention of knowledge about one's emotions; and (4) emotion regulation.

Some recent studies have applied EI theory to explore the utility of EI abilities in the reduction of stress. Slaski and Cartwright (2003) conducted an EI training study in which they trained office managers on EI skills such as self-awareness, emotion regulation, and recognizing emotions in others, among other techniques. Perceived stress significantly decreased pre to post for individuals who received EI training compared with those who received no training at all. This study supported a previous finding (Slaski & Cartwright, 2002) indicating that office managers who scored higher on EI measures tended to report less perceived work stress than those scoring lower on EI. Other research has reported that a buffering effect of some EI indicators may reduce the impact of stress on depressive symptoms (Ciarrochi, Deane, & Anderson, 2002).

Comparing the research on EI and stress with the DMA literature raises interesting questions about the importance of processing emotionally oriented stimuli in adaptation to stress. The DMA is associated with a clear set of findings that indicate a narrowing of affective space and, thus, a reduction of emotional complexity in the face of stress. Other research (Ong et al., 2006; Fredrickson, 2001; Zautra, Johnson, & Davis, 2005) suggests that the maintenance of PA during stressful episodes is representative of sustained emotional complexity and should be considered indicative of resilience. In contrast, it is not clear if heightened EI abilities confer resilience to stress. For instance, it is not known if EI abilities develop independently of stress or are shaped through the experience of stress. Furthermore, the studies that have explored EI and stress, to date, have used a cross-sectional design. The implementation of longitudinal design, then, would be an appropriate next step for this line of work. Future research is also necessary to clarify the mechanisms associated with emotional complexity under stress. Imaging studies using functional magnetic resonance and/or positron emission tomography would be useful in determining which brain regions account for heightened abilities in maintaining emotional complexity through stress.

STRESS AND HEALTH

The effects of stress on health outcomes are well documented in the literature, and other authors of chapters in this volume have provided comprehensive reviews of the relationship between stress and illness. We will not attempt to duplicate those efforts, but here we simply introduce key concepts relevant to our larger focus on emotions and health. Under conditions of stress, the sympathetic nervous system is activated and prepares the body for fighting or fleeing. Epinephrine and norepinepherine are released, resulting in an increased heart rate and blood pressure, and a diversion of energy away from nonessential systems such as reproduction, digestion, and growth, and toward large muscles (Sapolsky, 1994). In addition to disrupting human health by affecting cardiovascular parameters, chronic stress can impair health through activation of the hypothalamic–pituitary–adrenal (HPA) axis. When production of cortisol, the primary human hormonal product of the HPA, is increased by chronic stress, certain components of the immune system become inhibited, and energy stores are released, elevating blood glucose levels (Dickerson, Gruenewald, & Kemeny, 2004). Here again we defer to the work of other authors in this volume on the complex relationships between stress, physiological activity, and physical health.

NEGATIVE EMOTIONS, STRESS, AND HEALTH

Perhaps because of the close relationship between negative emotions and stress, much research on emotions and health has tended to focus on the role of negative emotional states and health. Negative mood has been associated with reduced natural killer cell (NKC) activity (Valdimarsdottir & Bovbjerg, 1997) and with a reduction in the proliferative response to a T-cell mitogen (Futterman, Kemeny, Shapiro, & Fahey, 1994). Koh (1998) found that patients with depression, which is characterized by negative mood, showed inhibition in several immune system parameters. In addition, psychiatric in-patients with depression have been shown to have a poorer blastogenic response than nondepressed control patients (Stein, Keller, & Schleifer, 1985), a lower percentage of helper T-lymphocytes (Krueger, Levy, Cathcart, & Fox, 1984), and a 50% reduction in NKC cytotoxicity (Irwin et al., 1990). Immune suppression may occur in a graded fashion across a spectrum of negative emotion, as evidenced by findings that lymphocyte response to certain mitogens was much lower for psychotic and severely melancholic inpatients than for patients with minor depression (Maes, Bosmans, Suy, Minner, & Raus, 1989).

Depression is also a significant risk factor for cardiovascular problems. A meta-analysis of depression showed the relative risk of developing coronary heart disease to be 2.69 for people with clinical depression compared with controls (Rugulies, 2002). It is, perhaps, no surprise that depression is associated with increased incidence of all-cause mortality. Barefoot et al. (2000) found that trait depression was predictive of a 32% increase in mortality risk for depressed patients undergoing coronary angiography, as compared with nondepressed patients, over an 11-year follow-up. These results appear to hold up across study populations and methods, as a meta-analysis of 25 studies of mortality and depression (Cuijpers & Smit, 2002) found that the overall relative risk of dying for depressed subjects was 1.81 compared with nondepressed subjects.

The effects of depression on pain and inflammation outcomes have been studied by members of our own research group. Interpersonal stressors are related to greater pain in patients with pain-related autoimmune disorders such as RA (Affleck, Tennen, Urrows, & Higgins, 1994; Zautra & Smith, 2001). Furthermore, that relationship is moderated by current depressive episodes, such that current depression contributes to an increase in pain reactivity to stress (Zautra & Smith, 2001). A history of emotion dysregulation also bears significance for an individual's current health. In a recent study, RA patients with two or more past episodes of depression had more pain at baseline, as well as greater pain in response to a stress induction, than patients with either zero or one prior episode, supporting the hypothesis that multiple depression episodes can lead to a lasting sensitization to social stressors (Zautra et al., 2007). Evidence suggests a link between depression, stress, and immune markers that are related to the inflammatory process in RA (Evers, Kraaimaat, Geenen, Jacobs, & Bijlsma, 2003; Zautra et al., 2004), providing a possible physiological mechanism by which multiple depressive episodes can cause or exacerbate inflammation-related joint pain in RA patients.

As research into stress and health outcomes grows, both the emotional predictors and the outcomes can be examined with greater detail and specificity. The need for this specificity has become clear as studies have suggested that general classes of emotional upset, such as depression, can be misleading. To qualify for a diagnosis of major depression, for example, a participant must first report feeling depressed or "blue" for a period of 2 weeks or more. Alternatively he or she could have a period of 2 weeks or more suffering a loss of capacity to experience pleasure. These choices introduce ambiguity about the nature of the depressive episode reported: Is it due to pervasive NAs, or the absence of PAs?

Anxiety, a state of apprehension or fear that can be diagnosed as a clinical disorder, is often comorbid with depression (Bakish, 1999). Like depression, anxiety is associated with incidence of cardiovascular events (Hemingway & Marmot, 1999) and is predictive of mortality in people after coronary artery bypass surgery (Tully, Baker, & Knight, 2008). However, both Tully et al.'s (2008) study and others (e.g., Strik, van Praag, & Honig, 2003) suggest that the relationship between depression and some health outcomes might be explained partially or wholly by anxiety. Strik et al. (2003) examined the effects of depression and anxiety on the risk of an incomplete recovery after a heart attack and found that anxiety accounted for the relationship between depression and future cardiac events. Similarly, Tully et al. (2008) found that for patients who had undergone open-heart surgery, depression approached, but it did not reach statistical significance for prediction of mortality, while anxiety nearly doubled the risk of mortality. These studies highlight the importance of distinguishing between types of negative emotions when assessing their effects on health outcomes.

One negative emotion in particular, anger, is gaining attention in the study of the health consequences of emotional expression. Although anger suppression has long been associated with heightened pain reactivity (Quartana & Burns, 2007), mounting evidence indicates that both trait anger expression styles and state anger expression episodes contribute to increases in pain sensitivity (for a review, see: Bruehl, Chung, & Burns, 2006). In one study, trait anger expression, known as "anger-out," produced elevated pain responses to an acute pain stimulus for chronic pain patients, suggesting that maladaptive anger regulation may be related to impaired endogenous opioid system functionality (Bruehl, Burns, Chung, Ward, & Johnson, 2002). That those effects were not significantly different for healthy subjects with a trait anger-out style suggests that the endogenous opioid dysfunction that accompanies chronic pain may be separate from that which is fostered by the expression of anger (Bruehl et al., 2002). The argument for an endogenous opioid pathway for anger-out effects on pain sensitivity was recently bolstered by findings that the A118G polymorphism of the μ-opioid receptor gene accounted for differences in pain sensitivity for high versus low anger-out participants (Bruehl, Chung, & Burns, 2008). In addition to its effect on the endogenous opioid system's modulation of the pain response, anger expression may indirectly contribute to the development of chronic pain symptoms through its effect on adipose tissue distribution and muscle tension (Bruehl et al., 2006; Burns, 1997; Raikkonen, Matthews, Kuller, Reiber, & Bunker, 1999), although further refinement and direct tests of these hypotheses are necessary. Other work concerning effects of anger on health is discussed elsewhere in this volume in connection with hostile personality.

In addition to increasing the amount of attention given to specific emotions as predictors of health outcomes, there is a need for greater specificity in identifying the stressors that precipitate those emotions. Social threats provoke unique responses compared with other stressors that are often used in a laboratory setting, such as mathematical or memory tasks (Dickerson et al., 2004). It has been suggested that shame, for example, serves a social function by being associated with submissive gestures found in both humans and primates (Gilbert, 2000). In humans, shame is associated with de-escalation of conflict and increased cooperation from interaction partners (Keltner, Young, & Buswell, 1997).

As a unique threat with a corresponding emotion, it follows that a social stressor may precipitate a unique health outcome. A meta-analysis of stressors with a social-evaluative aspect that might induce shame indicated that these stressors were associated with greater salivary cortisol response than stressors without a social component (Gruenewald, Kemeny, Aziz, & Fahey, 2004). Cortisol responses were further heightened when social threats were combined with uncontrollability, and cortisol levels took longer under these conditions to return to baseline. The immune system also seems to be affected differentially by social versus nonsocial threats; social-threat stressors lead to an increase in proinflammaory cytokines (Ackerman, Martino, Heyman, Moyna, & Rabin, 1998), whereas other stressors do not necessarily produce this increase (Peters et al., 1999). In addition, not only can a particular stressor specify an immune response, but so too can a specific emotional reaction paired with the stressor. Individuals exposed to a stressor designed to elicit self-blame showed greatest tumor necrosis factor-α activity if they endorsed the emotion shame, as opposed to guilt, anger, sadness, and other negative emotions (Peters et al., 1999).

POSITIVE EMOTIONS, STRESS, AND HEALTH

Although the lion's share of research on emotions and health has focused on the harmful impact of negative emotions, a growing chorus of researchers has turned the field's attention to the potential benefits of positive emotion (Chesney et al., 2005; Pressman & Cohen, 2005). The physiological correlates of highly arousing and negatively valenced emotions such as anger or fear are easily detected through examination of sympathetic nervous system activation. Some positive emotions, such as excitement and joy, also carry high-arousal signatures, whereas other positive emotions, such as feelings of calm and serenity, do not. Examination of parasympathetic activity during calming positive engagement may reveal the equilibrating influence of those kinds of positive emotions. For example, Bernardi et al. (2001) found that yoga mantras and rosary prayer induced healthier cardiovascular rhythms. The undoing model (Fredrickson, Mancuso, Branigan, & Tugade, 2000) may shed light on how positive emotions exert their influence on health outcomes. According to the model, positive emotions do not, themselves, lead to a specific action, but rather undo the stimulating effects of negative emotions and serve to return the body to homeostasis. Several studies by Fredrickson tested this hypothesis by experimentally inducing high-arousal negative emotions in participants, which resulted in increases in heart rate, blood pressure, and vasoconstriction. Participants were then instructed to view a film designed to elicit feelings of joy, contentment, neutrality, or sadness. Participants who experienced more positive emotions showed quicker cardiovascular recovery than those who viewed the neutral or sad films (Fredrickson et al., 2000). More work is needed to identify the unique physiological signatures of positive experiences beyond recovery of homeostasis. More attention to opioidergic and dopaminergic pathways may provide the evidence needed to quantify neuroendocrine responses that accompany positive emotions that arise from goal attainment and approach motivation.

There is also substantial evidence that positive emotional states are associated with better immune regulation. Futterman et al. (1994) found that induction of PA led to a heightened proliferation in response to a T-cell mitogen from baseline. Other studies indicated that positive events led to significantly fewer respiratory infections over a 2-week period and that having significantly fewer positive events can predict the start of an infectious illness (Evers et al., 2003; Lyons & Chamberlain, 1994). A recent study found that PA also affects glycosylated hemoglobin, an indicator of glycemic control in people with diabetes and an independent predictor of cardiovascular health (Tsenkova, Dienberg Love, Singer, & Ryff, 2008).

Positive emotion has also been shown to influence mortality rates. Danner, Snowdon, and Friesen (2001) examined the autobiographies of nuns written before they took orders, some of them 50 years prior to the time of the study. Negative emotion expressed in the diaries did not predict mortality, but nuns who expressed the most positive emotion lived on average 10 years longer than the others. Moskowitz (2003) likewise found that PA, but not NA, was related to survival in patients with AIDS. Positive mood may, additionally, serve as a buffer of the effects of negative mood on immune function. In a study of NKC activity, immune activity for people with both high positive and high negative mood compared with that for those reporting no negative mood (Valdimarsdottir & Bovbjerg, 1997).

Optimism, conceived either as a situation-specific outcome expectancy or a personality trait, has often been associated with positive emotion (Aspinwall & Leaf, 2002; Scioli et al., 1997) and has been studied in relation to immunological response to stress. Segerstrom, Taylor, Kemeny, and Fahey (1998) found that situational optimism in law students during their first semester of law school was associated with higher numbers of helper T-cells and greater NKC cytotoxicity. In studies involving other health outcomes, optimistic and hopeful individuals were less likely to take sick days and were less likely to be diagnosed with common illnesses like hypertension, diabetes mellitus, and respiratory track infections than their counterparts (Kivimäki et al., 2005; Richman et al., 2005). Furthermore, a prospective study of elderly members of a Dutch community found that those reporting a high level of optimism showed a lower incidence of all-cause mortality and an even greater decrease in cardiovascular mortality than those low in optimism (Giltay, Geleijnse, Zitman, Hoekstra, & Schouten, 2004).

Researchers have also examined positive emotion through the study of well-being. Two types of well-being that have been distinguished are worth noting here: hedonic and eudaimonic well-being (Barak, 2006; Ryan & Deci, 2001). Hedonic well-being encompasses positive emotions such as pleasure, happiness, and PA and has been described as "subjective well-being" (Ryff, Singer, & Love, 2004). In contrast, eudaimonic well-being refers to personal growth and development, with components including self-acceptance, purpose in life, personal growth, positive relations with others, environmental mastery, and autonomy (Ryff et al., 2004). Ong and Zautra (2008) point out that these two approaches are best thought of as complementary. Eudaimonic efforts lead to, and are reinforced by, hedonic outcomes.

Resilience has been described as the ability to "bounce back" from stressful experiences (Carver, 1998) and has been linked to positive emotionality through a variety of pathways, including openness to experience (Block & Block, 1980) and coping mechanisms (Masten, 2001). Furthermore, it correlates primarily with PA, but not NA (Tugade, Fredrickson, & Barrett, 2004). Like PA, trait resilience is associated with faster cardiovascular recovery from negative emotions (Tugade et al., 2004) and a diminished negative affective reaction to pain exacerbations (Zautra, Johnson, Davis, & Fasman, 2005).

The theme of "resilience" is evident in recent studies of emotion regulation. For example, Fredrickson (1998, 2001) has proposed that positive emotions broaden an individual's resource portfolio in the face of stress. Specifically, adaptive cognitions and behaviors are thought to be more readily retrieved and employed in the face of a stressor when positive emotionality is high than when it is low. In the language of the DMA, positive emotions counteract the force of stress in shrinking affective space. Although stress serves to increase NA, individuals who can sustain PA through stressful times appear to maintain a high level of information processing and emotional complexity and avoid the potentially harmful consequences of chronic, unmitigated NA (Tugade & Fredrickson, 2004; Zautra, Davis, Affleck, Tennen, & Reich, 2005).

A recent study by Ong, Bergeman, Bisconti, and Wallace (2006) extended theory on affective differentiation and resilience by showing that positive emotion not only moderated the effect of daily stress on negative emotion but also significantly diminished the effects of stress on next-day negative emotion. In addition, no relationship was observed between daily positive and negative emotion among people who scored high on a trait resilience measure (Ong et al., 2006), suggesting that resilient people are characterized by greater differentiation in affective experiences.

Zautra, Hall, and Murray (2008) call for more study of cognitive–affective and social processes like positive engagement, optimism, and strong social ties that lead to resilience following stress. They also broaden the definition of resilience to include the study of the sustainability of positive engagements in the face of adversity. The capacity to endure under stressful conditions is likely influenced by cognitive–emotional and social processes different from those typically identified when examining recovery of homeostasis following distressing events. A greater focus on those processes may add considerably to the scope of work and utility of stress–diathesis models to predict long-term health outcomes like survival and physical functioning in aging populations.

IMPLICATIONS FOR TREATMENT

The dominant Western therapeutic approach to treating mood disorders over the past half century has been rooted in theory in which intractable negative mood results from a habitually irrational cognitive appraisal of emotional stimuli (Beck, 1967, 1987). Under the framework of the diathesis–stress model, a diathesis (e.g., cognitive vulnerability; Abramson, Metalsky, & Alloy, 1989) is thought to create a vulnerability to depression that may be actualized when the individual encounters a stressor with sufficient potency (e.g., negative life events; Kessler, 1997). Depression, for example, is thought to result from a dysfunction in cognitive processing brought about by acute or chronic activation of latent diatheses by psychological stressors (Monroe & Simons, 1991). Cognitive theories of psychopathology, then, contend that the treatment of mood disorders generally proceeds first through the identification of negative patterns of thinking, or self-schemata (Beck, 1967, 1987). These negative schemata promote a cascade of dysfunctional thoughts about one's self-worth, the world, and the future, known collectively as the "negative cognitive triad." Beck (1976) asserted that the cognitions responsible for the automaticity of negative appraisals of emotional stimuli are necessarily distorted and, thus, should be targeted for change in the therapeutic context. Ideally, the result of successful cognitive therapy should be a reduction in the frequency and intensity of negative emotions thought to be maintained by distorted cognitions.

Although cognitive therapy remains the gold standard for the psychological treatment of mood disorders, a growing body of evidence supports the notion that therapy need not focus principally on the reduction of negative cognitions and emotional states. Treatments that target the promotion of positive emotional resources are being viewed instead as excellent complementary, if not primary, treatment options (Folkman & Moskowitz, 2000; Hamilton, Kitzman, & Guyotte, 2006). Clinically, the technique for maximizing a patient's general fund of positive emotion and emphasizing its importance as a resilience resource in times of elevated stress may not differ substantively from that employed for the reduction of negative emotion in cognitive therapy. For example, Folkman and Moskowitz (2000) note the efficacy of positive reappraisal, a strategy used to reframe a situation with a positive tone, in bringing about increases in PA for caregivers of dying and recently deceased HIV patients (Moskowitz, Folkman, Collette, & Vittinghoff, 1996). In the same study, problem-focused coping, which involves the active management of conditions that cause distress (Folkman & Moskowitz, 2000), was associated with an increased sense of mastery and control during conditions in which caregivers had no ostensible control of their partner's declining health. Thus, strategies commonly employed in traditional cognitive-behavioral approaches to reducing negative emotion can with some success be modified to focus on enhancing positive emotion (see also: Aldwin, 1994). It appears that focus on the positive need not, and perhaps should not, neglect the negative in building interventions that enhance resilience.

As detailed earlier, chronic NA and stress can result in harmful health consequences, which, in turn, serve to promote and maintain further negative affective states. However, a substantial amount of literature indicates that PA can provide a buffer against these effects. As such, researchers have explored the utility of interventions designed to enhance PA in ill populations. Coping effectiveness training (CET; Chesney, Chambers, Taylor, Johnson, & Folkman, 2003), delivered in a group setting, encourages participants to log daily positive events in a diary format, share those positive experiences with the group, engage in benefit finding, and laugh with each other as a coping response. In a randomized controlled trial of CET with HIV-positive men, patients who received CET evidenced decreases in perceived stress, burnout, and anxiety, and increases in positive states of mind, compared with participants in control groups. It was found that coping efficacy mediated some of the CET effects.

Another therapeutic approach to enhancing PA, known as mindfulness-based stress reduction (MBSR; Kabat-Zinn, 1990), dispenses with the notion that coping with stress should involve active, approach-oriented problem solving. Instead, MBSR, which has its roots in Eastern meditation practice and philosophy, adopts an active but observant stance, whereby emotions, thoughts, and physical sensations are noticed and accepted as part of the flow of life. Meditations are encouraged to be practiced on a moment-to-moment basis throughout even the most mundane daily activities like gardening, exercising, or driving (Kabat-Zinn, 1990). Recent evidence indicates that within-day, moment-to-moment experience of PA, assessed through the ecological momentary assessment paradigm, buffers against genetic influences on NA (Wichers et al., 2007). Such evidence strengthens the position that mindfulness-oriented therapy might provide significant benefits to individuals suffering from depression and other disorders characterized by high NA and low PA. Rather than guide the individual through a Socratic exploration of a problem and its origin, MBSR treats negative cognitive and emotional intrusions as transient occurrences and facilitates the accentuation of one's stable positive features, such as the ability to forgive, hope, or savor (Hamilton et al., 2006).

Engaging in MBSR has been shown to be a promising intervention for aiding adaptation to a variety of physical and psychological disorders. Specifically, reductions in pain (Goldenberg et al., 1994; Kabat-Zinn, 1982), stress (Astin, 1997), anxiety and depression symptoms (Shapiro, Schwartz, & Bonner, 1998; Teasdale et al., 2000), psoriasis symptoms (Kabat-Zinn et al., 1998), and disordered eating behaviors (Kristeller & Hallett, 1999), as well as increases in positive mood (Bishop, 2002), have all been reported following mindfulness-based interventions. Our research group recently conducted a randomized clinical trial comparing a mindfulness meditation-based intervention with an emphasis on the promotion of PA to cognitive-behavioral therapy for pain and an education control condition (Zautra et al., 2008). We found that the mindfulness-based intervention was most effective for RA patients with a history of recurrent depression. This group experienced greater elevations in positive emotion and vitality and larger decreases in NA and joint pain relative to participants in other intervention conditions, suggesting mindfulness-based methods are particularly valuable for those with difficulty in emotion regulation. As further support, two meta-analyses (Baer, 2003; Grossman, Niemann, Schmidt, & Walach, 2004) have concluded that MBSR confers a moderate to large effect across illness populations. More studies, however, are still needed to compare mindfulness-based interventions with another active treatment before verifying the potential for these methods to improve emotion regulation among the chronically ill.

CONCLUSION

In the exploration of stress and emotion, a good adage may be, "the deeper one looks, the more one finds." Emotions operate in specific, yet complex, capacities in human adaptation to stress. Individuals may simultaneously be motivated to act in accord with emotional predispositions and to respond to seemingly incompatible demands in the immediate environment. Clearly, differentiating between emotions requires a significant contribution of cognitive resources to maintain a high level of information processing. Under conditions of uncertainty, those resources can be depleted, and affective differentiation becomes more difficult.

By examining the influence of discrete emotions, it becomes clear that health outcomes resulting from stress are often emotion specific. Negative emotions experienced through clinical disorders like depression and anxiety, for example, decrease immune function and increase the risk of death. However, as recent research has indicated, the health benefits of positive emotion, independent of negative emotion, are real and are still being uncovered. With more attention to how people are able to be emotionally resilient, it is likely that pathways to adaptation will continue to be revealed, informing researchers and clinicians alike.

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