Journal of Personality and Social Psychology
2003, Vol. 85, No. 4, 605–615

0022-3514/03/$12.00 DOI: 10.1037/0022-3514.85.4.605

Are Self-Enhancing Cognitions Associated With Healthy or Unhealthy Biological Profiles?

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Self-enhancement is variously portrayed as a positive illusion that can foster health and longevity or as defensive neuroticism that can have physiological–neuroendocrine costs. In a laboratory stress-challenge paradigm, the authors found that high self-enhancers had lower cardiovascular responses to stress, more rapid cardiovascular recovery, and lower baseline cortisol levels, consistent with the positive illusions predictions and counter to the predictions of the defensive neuroticism position. A second set of analyses, replicating the "illusory mental health paradigm" (J. Shedler, M. Mayman, & M. Manis, 1993), also did not support the defensive neuroticism hypothesis. The association between self-enhancement and cortisol was mediated by psychological resources; analyses of the cardiovascular results provided no definitive mediational pathway. Discussion centers on the potential stress-buffering effects of self-enhancing beliefs.

The potential benefits and liabilities of self-enhancement have been important and controversial research topics in social psychology for the past several decades. Research on positive illusions (Taylor, 1989; Taylor & Brown, 1988) has amassed evidence for beneficial effects of self-enhancement on mental functioning. However, proponents of the view that self-enhancement reflects little more than defensive neuroticism (e.g. Colvin, Block, & Funder, 1995; Paulhus, 1988; Shedler, Mayman, & Manis, 1993) have argued for a negative relation between self-enhancement and mental health. In recent years, this controversy has extended into the biological arena.

Self-Enhancement and Biological Stress Regulation

The positive illusions framework has provided evidence that falsely positive views of one's medical condition and of one's personal abilities to influence it foster health and longevity. For example, in a series of studies with people infected with HIV or diagnosed with AIDS, evidence revealed that those who held unrealistically positive views of their likely course of illness showed a less rapid course of illness (Reed, Kemeny, Taylor, & Visscher, 1999) and a longer time to death (Reed, Kemeny, Taylor, Wang, & Visscher, 1994; for reviews, see also Bower, Kemeny, Taylor, & Fahey, 1998; Taylor, Kemeny, Reed, Bower, & Gruenewald, 2000). Taylor et al. (2000) speculated that positive illusions may keep physiological and neuroendocrine responses to stress at low levels, as reflected in lesser autonomic activation and lower hypothalamic–pituitary–adrenocortical (HPA) axis responses to stress. That is, when engaged by stressful circumstances, the autonomic nervous system and the HPA axis become activated and mobilize resources so that the organism is prepared for "fight or flight." Although these responses are protective in the short term, over the long term, recurrent or chronic activation of these systems can confer damage with adverse implications for health (e.g. McEwen, 1998).

A goal of the present study was to ascertain if and how the self-enhancing cognitions of healthy adults might be similarly associated with indicators of stress regulation, specifically autonomic and HPA axis responses to stress. Our reasoning was that if positive perceptions of the self help a person to manage stressful conditions, then biological responses to stress may typically be lower or less frequent for people high in self-enhancement. As a result, those higher in self-enhancement might experience a lesser chronic toll on their stress regulatory systems than those without this resource by virtue of less wear and tear across the numerous stressful events to which people are inevitably exposed. Accordingly, one might expect self-enhancement to be associated with both chronically better regulated stress systems as well as lower acute responses to stress (cf. McEwen, 1998).

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This research was supported by National Institute of Mental Health (NIMH) Grant MH056880 and by funds from the MacArthur Foundation's SES and Health Network to Shelley E. Taylor. Jennifer S. Lerner was supported by NIMH Grant MH62376 and a grant from the Fetzer Foundation. Jennifer S. Lerner, David K. Sherman, and Rebecca M. Sage were supported, in part, by NIMH Training Grant 15750. We are grateful to Marisa Callaghan, Sara Fernandes-Taylor, Jennefer Harmon, Matthew Loew, Justin Malakhow, Urvi Patel, Jeffrey Prager, Regan Roby, and Heidi Stayn for their assistance on this project and to John Updegraff for his statistical assistance.

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In contrast to this viewpoint, some theorists and researchers have suggested that self-enhancement may be little more than a defense mechanism of denial or repression in a healthy guise (see H. J. Eysenck, 1994; Shedler et al., 1993). Self-enhancement has been characterized as reflecting defensive neuroticism that leads to self-deceptive suppression of negative information about the self (e.g., Myers & Brewin, 1996; Paulhus, 1998; see also Bonanno & Singer, 1990; Weinberger, 1990; Weinberger & Schwartz, 1990). The suppression or repression of negative information is believed to be physiologically taxing, so if the defensive neuroticism account of self-enhancement is correct, one might expect to see adverse physiological and neuroendocrine concomitants associated with self-enhancement. Likely manifestations would appear in the form of overactive stress systems, such as high or poorly regulated autonomic functioning or elevated HPA axis activity.

This perspective is potentially consistent with work by Gross (e.g., Gross & Levenson, 1997), who found that explicit efforts to suppress negative feelings produce high levels of autonomic activity. Pennebaker and colleagues (Pennebaker, 1997; Pennebaker & Graybeal, 2001) have found that inhibiting negative thoughts and feelings has physiological costs that may enhance susceptibility to illness. Taken together, this evidence suggests that if self-enhancement reflects a defensive suppression of negative information, then there are likely to be biological costs, potentially in the form of compromised stress-regulatory systems.

This hypothesis was explicitly tested by Shedler and his colleagues (Shedler et al., 1993) in research that examined the "illusion of mental health." Shedler and colleagues maintained that among people who look mentally healthy according to self-report measures of mental health, there are two subgroups, one of which is composed of people who are truly psychologically healthy, the other of people who are psychologically distressed; this latter group was characterized by Shedler et al. (1993) as maintaining an illusion of mental health through the defensive denial of psychological distress. Shedler et al. argued that in contrast to mental health scales, clinical judges may do a superior job of distinguishing between the two groups.

In their investigations, Shedler et al. (1993) administered the Early Memory Test (EMT), which elicits thoughts of early childhood and earliest memories from participants. These data provided the primary protocols that their clinical judges used for evaluating participants. In addition, participants completed a self-report measure of mental health, the Eysenck Neuroticism Scale (S. B. G. Eysenck & Eysenck, 1975). Participants were then exposed to a series of psychological stressors in the laboratory, and cardiovascular activity was assessed for three groups: those judged to be mentally healthy by both self-report and clinical judgment, those judged to have "illusory mental health" indicated by a healthy self-report but clinical judgment indicating distress, and manifestly distressed individuals classified by both data sources as distressed. Using a psychoanalytically trained, experienced clinician (in Study 1) and college student judges (in Study 2), Shedler et al. reported evidence to suggest that those showing illusory mental health had higher cardiovascular reactivity (assessed by rate pressure product) during the laboratory tasks than those judged to be genuinely mentally healthy.

Thus, the two views of self-enhancement, one as a beneficial positive illusion, the other as defensive neuroticism, make opposite predictions concerning the relation of self-enhancement to biological stress responses. The present study provided an opportunity to test these opposing predictions by assessing autonomic (heart rate, blood pressure) and HPA axis functioning (cortisol) at baseline, in response to an acute stress challenge and at recovery following exposure to stress.

Mediation of Self-Enhancement and Biological Stress Regulation

An important question raised by this controversy is how any beneficial or adverse effects of self-enhancement on stress regulatory systems might be mediated. A first possible mediator is via psychological distress. Psychological distress has been tied directly to physiological and neuroendocrine changes prognostic for illness as well as to the development of several chronic diseases (Cohen & Herbert, 1996; Frasure-Smith, Lesperance, & Talajic, 1995; Friedman & Booth-Kewley, 1987; Herbert & Cohen, 1993). Anxiety and depression have been associated with abnormal diurnal rhythms in HPA responses to stress (Chorpita & Barlow, 1998; Chrousos & Gold, 1992), and negative affective states such as hostility have been tied to heightened heart rate and blood pressure responses to stress (e.g. Dembroski, MacDougall, Williams, Haney, & Blumenthal, 1985). If positive illusions keep negative affect at low levels, or conversely, if self-enhancement defensively masks anxiety or other negative emotions, then these negative emotions may represent the pathway whereby self-enhancement influences biological stress systems.

A second possible mediator of relations between self-enhancement and biological stress regulatory systems is via psychological health. Taylor and colleagues (Taylor, 1989; Taylor & Armor, 1996; Taylor & Brown, 1988) have maintained that positive illusions, including self-enhancement, are associated with the criteria normally thought to be indicative of mental health (see, e.g., Jahoda, 1958; Jourard & Landsman, 1980). Both experimental and naturalistic investigations of people confronting stressful events have documented that those who show evidence of positive illusions are somewhat better adjusted on measures reflecting mental health (e.g., Taylor et al., 2000; Taylor & Gollwitzer, 1995; for a review, see Updegraff & Taylor, 2000). Taylor et al. (2000) reported that those who evidenced illusion-based responses to HIV infection nonetheless maintained good health longer than those who did not. In sum, self-enhancement may contribute to mental health, which in turn mediates beneficial effects on biological responses to stress. The well-documented comorbidities between mental and physical health outcomes may reflect this relation.

A third potential mediator is psychosocial resources. Stress researchers have long noted that people with resources such as a sense of personal control or optimism are better able to manage stress both psychologically and biologically than those with fewer such resources (e.g., Aspinwall & Taylor, 1997; Fredrickson, 2001; Taylor et al., 1992). Psychosocial resources may enable people to guard against or offset stressful events before their implications may be felt or may enable people to cope more actively with stressful events and minimize their adverse physiological and neuroendocrine consequences; alternatively, if self-enhancement represents a defensive neurotic process, then the psychological resources of self-enhancers may be impoverished. Either way, these resources represent a viable mediational pathway between self-enhancement and its effects on biological stress-

regulatory systems. The present study assessed these three potential mediators to permit tests of the pathways by which self-enhancement may influence biological stress-regulatory systems (Kenny, Kashy, & Bolger, 1998).

Method

Overview

Participants completed self-report measures of self-enhancement, mental health, psychological distress, and psychological resources potentially related to the two perspectives on self-enhancement noted above. Within the following week, participants engaged in a laboratory stress challenge, during which cardiovascular responses and cortisol were assessed as measures of autonomic and HPA responses to stress, respectively.

Participants

Members of the University of California, Los Angeles (UCLA) campus community responded to an ad offering $60 in return for participating in the study. Prospective participants with the following conditions were excluded from participation on the grounds that the procedures might be too stressful or neuroendocrine measures might be affected by medication or preexisting conditions: serious physical or mental health problems, use of medications affecting cardiovascular or endocrine functions, current treatment from a mental health professional, or current use of mental-health-related medications (e.g., Prozac). In addition, because the study required neuroendocrine measures, pregnant and lactating women were excluded. So as not to incur problems with demand awareness, people with training in psychology (i.e., psychology majors and minors) were also excluded.

Ninety-two participants (45 men and 47 women) made up the final sample. All but 8 were currently taking at least one course at UCLA, and all were affiliated with UCLA in some capacity. Participants ranged in age from 18 to 29 years, with a mean age of 20.6 years. The sample was 43.5% European American, 43.5% Asian American, 8% Latino, 3% African American, and 2% other, a pattern that reflects the composition of the UCLA community. No participant dropped out during the course of the study.

Questionnaire Session

Participants reported to a computer laboratory where they completed informed consent forms and an extensive battery of psychosocial self-report scales. In order to ensure the privacy of responses, participants identified themselves by code numbers, and each participant sat at a computer situated about 10 ft away from other participants. The session lasted 3 hr in total, with two breaks for relaxation.

Participants completed the How I See Myself Questionnaire (HSM; Taylor & Gollwitzer, 1995), a measure of self-enhancement. The scale consists of 21 positive qualities or skills (e.g., academic ability, self-respect) and 21 negative traits and characteristics (e.g., selfish, pretentious). Participants rate themselves in comparison to peers as to how much each positive and negative characteristic describes them on a scale from 1 (*much less than the average college student of my age and gender*) to 7 (*much more than the average college student of my age and gender*). The HSM was selected because it is a face-valid measure of self-enhancement that has been used in prior research (e.g. Taylor & Gollwitzer, 1995), thereby providing a point of comparison. In a study of predictors of mental health, the HSM was more highly correlated with assessments of psychological functioning than were several other measures of self-enhancement (Taylor, Lerner, Sherman, Sage, & McDowell, 2003).

To provide a test of the defensive neuroticism perspective on self-enhancement, participants completed the EMT (Mayman, 1968; Shedler et al., 1993). The EMT instructs participants to relax, allow their thoughts to go back to early childhood, and recall their earliest memory. It then prompts for a written account of that memory. Open-ended follow-up questions ask subjects for their impressions of themselves in the memory, their impressions of other people, and the mood or feeling tone associated with the memory. Following this format, the test inquires about several additional early memories. For the full text of the measure, the reader is referred to Shedler et al. (1993).

Measures of psychological health consisted of the Psychological Health Scales (Ryff, 1989; Ryff & Singer, 1996) of personal growth, autonomy, positive relations with others, purpose in life, and self-acceptance. Measures of psychological distress included the Beck Depression Inventory (Beck, 1967), the Neuroticism scale of the Eysenck Personality Inventory (S. B. G. Eysenck & Eysenck, 1975), the Spielberger State–Trait Anxiety Inventory (Spielberger, Gorsuch, & Lushene, 1971), the Cook–Medley Hostility scale (Cook & Medley, 1954), and the SCL-90-R Brief Symptom Inventory (Derogatis & Spencer, 1982).

Several scales assessed psychological resources that might relate to self-enhancement, including the Life Orientation Test (LOT; Scheier & Carver, 1985), a measure of dispositional optimism; the Rosenberg Self-Esteem Scale (Rosenberg, 1965); the Pearlin Mastery Scale (Pearlin & Schooler, 1978); the Extraversion scale of the Eysenck Personality Inventory (S. B. G. Eysenck & Eysenck, 1975); the Giving and Receiving Support scale from the MacArthur Foundation Research Network on Successful Midlife Development (MIDI; Brim, 2000); the COPE (Carver, Scheier, & Weintraub, 1989), an inventory of coping responses with respect to what people "generally do and feel when they experience stressful events"; the Subjective Happiness scale (Lyubomirsky & Lepper, 1999); and the Work and Community Involvement scales from the MIDI (the "work" items were adapted to reflect the UCLA school environment; Brim, 2000). Several questionnaires that address other research issues were also included but were not analyzed for the present study.

Stress Challenge Tasks and Procedures

Within a week after completion of the personality measures, participants reported to the laboratory for the second part of the study. All participants were scheduled to arrive in the afternoon between 2:30 p.m. and 4:30 p.m. to minimize variability due to the circadian rhythm of cortisol. The session began with a collection of two saliva samples from the participants for cortisol analysis. Participants rinsed out their mouths; briefly chewed a piece of sugarless gum and rolled a sterile cotton swab in their mouths for 1 min, 45 s; and then placed the swab in a Salivette salivary collection tube (Sarstedt, Inc., Newton, NC). Samples were immediately placed on ice in a cooler and transferred within the next few minutes to a freezer. Participants then responded to a set of interview questions about their home life, friendships, romantic relationships, work, hobbies, and ways of coping, material that is not part of the present analyses.

Participants were next escorted into the laboratory for the stress-challenge portion of the study, and autonomic and HPA axis responses to the tasks were assessed. This procedure provided an opportunity to assess whether self-enhancement represents an effortful, repressive process that adversely affects stress responses or a psychological resource that helps people get through stressful events with a lesser physiological and neuroendocrine toll.

Setting and apparatus. Participants sat at a table adjacent to the cardiovascular equipment and directly in front of an occluded video camera. The video camera was turned off and hidden behind a curtain when participants arrived. In order to make the initial setting relaxing, the camera was activated and visible only after the initial 10-min baseline cardiovascular measures were taken. A Critikon Dinamap Vital Signs Monitor Model 1846SX (Critikon, Inc., Tampa, FL) automatically and continuously recorded heart rate and blood pressure every 2 min throughout the laboratory session. The physiological readings were not visible to the experimenter until printed out by the Dinamap printer.

Rest and stress-challenge tasks. The laboratory session began with participants resting for 10 min while listening to pleasant music and getting used to the automatic blood pressure cuff. Measures taken at the end of this period served as baseline cardiovascular measures. Participants were then exposed to the stress-challenge tasks, which included (a) counting backward by 7s from 9,095 and (b) counting backward by 13s from 6,233. To increase the stressfulness of the situation, the experimenter informed participants that the arithmetic tasks were diagnostic of mental ability and general intelligence and that participants' responses would be compared with other participants' scores. Participants were told that in order to do well, they had to give the correct answer as quickly as possible, and during the protocol, participants were urged by the experimenter to try to go faster. Participant responses were recorded and timed by the video camera and also timed by the experimenter. The counting backward tasks have been found to induce stress in a broad array of stress studies; they constitute a major part of the standardized Trier Social Stress Task (Kirschbaum, Pirke, & Hellhammer, 1993), which is commonly used to evoke psychophysiological–neuroendocrine stress responses.

To provide a direct test of competing perspectives on self-enhancement, participants also completed three other stressful tasks used by Shedler et al. (1993): (c) mental arithmetic problems from the Wechsler Intelligence Test; (d) telling stories in response to threatening Thematic Apperception Test (TAT) cards; and (e) responding to a phrase association test, which included phrases with threatening, dependency, and sexual themes. These last two tasks are designed to elicit material about which participants may be defensive. The complete instructions are available in Shedler et al. (1993).[1]

Physiological measures. Cardiovascular measures included heart beats per minute, systolic blood pressure (SBP), and diastolic blood pressure; they were recorded automatically at 2-min intervals throughout the laboratory session. To calculate baseline levels on each index, we averaged the last four measures taken during the baseline phase, excluding the first measure because participants were still getting used to the cuff on their arms. For each of the stress tasks, we averaged heart rate and systolic and diastolic blood pressure readings, creating one index on each variable for each task.

Immediately following completion of the stress-challenge tasks, a second set of two cortisol measures was taken. The time corresponds to approximately 25 min following the initiation of the stressors, a time period for which cortisol responses to stress, if any, would begin to show a rise.

At this point, a 30-min recovery period began. During the beginning of the recovery period, participants completed an additional packet of questionnaires to assess their daily activities such as smoking or exercise that might have influenced their cardiovascular and cortisol responses. Demographic characteristics including gender, ethnicity, socioeconomic status, year in school, citizenship, birthplace of parents, and marital status were also assessed. At the end of the 30-min recovery period, a third cortisol sample was taken and a third set of heart rate and blood pressure responses were computed (average of last two readings). Participants were then debriefed and dismissed.

Salivary Cortisol Assay Procedures

Saliva samples were shipped for overnight delivery on dry ice to the Behavioral Endocrinology Laboratory at the Pennsylvania State University where the cortisol assays were conducted. Salivary cortisol levels were determined from a 25-μml sample, which was assayed in duplicate by radioimmunoassay using the HS-Cortisol High Sensitivity Salivary Cortisol Enzyme Immunoassay Kit (Salimetrics, LLC, State College, PA). All samples were tested with a single assay batch, eliminating error that might occur because of differences between assay batches. The HS-Cortisol assay allows for robust results when the saliva samples have a pH within the range of 3.5–9.0. All samples were within this pH range.

Clinician Ratings

Following the procedures of Shedler et al. (1993), we recruited an experienced, psychoanalytically oriented clinician in private practice to assess participants' mental health from the EMT. Using Shedler et al.'s guidelines, the clinician was familiarized with the test and a subset of the materials. After he felt sufficiently familiar with the materials and the guidelines for their use, he rated the EMT protocols. He was asked to "attend to qualitative factors such as how the self was represented, how the interpersonal world was represented, the affective tone of the material, whether the memories were narratively coherent or contained inner contradictions (suggesting omissions and distortions)." The clinician was unaware of all other data on participants. He recorded dichotomous judgments, classifying subjects as relatively healthy or relatively distressed, following Shedler et al. He also made a confidence judgment on a 3-point scale from 1 (*not very confident*) to 3 (*very confident*).

In addition, we recruited three student judges to make ratings of the EMT protocols. Shedler et al. (1993) had validated their clinician reports against samples of student judges and found that through aggregation, a modest degree of agreement could be achieved between the psychoanalytically trained clinician and the judges (with correlations ranging from .25 to .62, depending on the amount of aggregation). Subsequently, to adapt the EMT for coding by a broader range of investigators, including researchers who lacked clinical training, Shedler, Karliner, Katz, and Mayman (1995) developed the Adelphi Early Memory Index (AEMI), which provides coding criteria for the EMT. We trained our student judges in use of the AEMI, which largely follows the instructions for the EMT and yields a score on a 5-point scale ranging from -2 (distressed) to $+2$ (healthy). Following training and practice on a subset of the protocols, the three coders achieved an interrater reliability of .91, thus showing high reliability.

Results

Preliminary Analyses

In preliminary analyses, we ascertained whether our stress-challenge tasks had produced significant changes in measures of autonomic and HPA axis activity. Comparing baseline with stress measures revealed significant increases in heart rate and blood pressure for all five stress tasks (all ps $< .01$). Comparing baseline with stress cortisol responses also revealed a significant increase, $t(91) = 2.83$, $p < .01$. These results confirm that the stress challenges had a significant impact on stress-related autonomic and HPA axis responses.

Self-Enhancement

To create a self-enhancement measure, negative items on the HSM instrument were reverse coded, and the 42 items were averaged. Scores below 4.00 represent self-deprecation relative to peers, scores of 4.00 represent no self-enhancement, and scores greater than 4.00 represent self-enhancement relative to peers. The overall mean of the sample was 4.69, which was significantly greater than the midpoint (4.00), $t(91) = 11.39$, $p < .01$. The

[1] Our original plan had been to replicate only Shedler et al.'s (1993) stress tasks, but pilot testing revealed them to be only moderately stressful. Accordingly, we added to the protocol the task of counting backward under harassing conditions to ensure the existence of a highly stressful task and to increase the likelihood of a cortisol response to the laboratory challenges.

median of the sample was 4.68; from this, we performed a median split, which yielded two groups: low self-enhancers ($n = 46$) and high self-enhancers ($n = 46$). Of the 92 participants, 11 had scores below 4.00, 1 scored 4.00, and 80 had scores greater than 4.00. Men ($M = 4.65$) did not differ from women ($M = 4.72$), $t(91) = .66$, *ns*. There were no differences between the two largest demographic groups, Asian Americans ($n = 39$, $M = 4.66$) and European Americans ($n = 34$, $M = 4.76$), $t(71) = .73$, *ns*. Thus, as in previous investigations of positive illusions, the majority of participants (87%) regarded themselves more positively than an average peer of their same age and gender.

Biological Concomitants of Self-Enhancement

Previous research from our laboratory has provided evidence that positive illusions promote physical as well as mental health and has argued that autonomic and HPA axis responses to stress may be a pathway by which these effects occur. In contrast, researchers arguing for the defensive neuroticism position have maintained that repression or suppression of threatening information about the self, as may be reflected in positive illusions, is associated with increased stress responses to challenging circumstances. We assessed these competing predictions in several ways.

Blood pressure and heart rate analyses. For the SBP data, we had measures for baseline, counting (average for 7s and 13s), arithmetic, TAT, phrase association, and recovery periods. We submitted the data to a repeated-measures analysis of variance (ANOVA) with self-enhancement (high vs. low split at the median) as the between-subjects variable and the six time periods as the repeated measure. For some subjects, physiological measurements for the final rest period were missing; hence subsequent analyses are based on $n = 85$ (for blood pressure) or $n = 86$ (for heart rate). There was a main effect of time period, $F(5, 415) = 153.05$, $p < .01$, indicating that the different time periods–tasks evoked differential blood pressure responses. There was also a main effect of self-enhancement, $F(1, 83) = 4.26$, $p < .05$. Across the six time periods, high self-enhancers had lower SBP ($M = 118.61$) than low enhancers ($M = 124.51$). Of key importance is a significant Time × Self-Enhancement interaction, $F(5, 415) = 3.71$, $p = .003$. As can be seen in Table 1, the significant interaction is largely driven by the fact that high self-enhancers ($M = 109.61$) and low self-enhancers ($M = 108.74$) did not differ significantly at baseline in their SBP, $t(90) = .41$, *ns*, but during the four stress tasks, low self-enhancers had, or tended to have, higher SBP than high self-enhancers: counting (134.28 vs. 127.96), $t(89) = 1.83$, $p = .07$; arithmetic (129.65 vs. 125.58), $t(90) = 1.14$, $p = .25$; TAT (128.69 vs. 123.44), $t(89) = 1.70$, $p = .09$; and phrase association (128.00 vs. 120.31), $t(90) = 2.53$, $p = .01$.

We conducted the same analyses for heart rate (beats per minute) and obtained similar results. Once again, there was a main effect of time period, $F(5, 420) = 110.22$, $p < .01$, indicating that the different time periods–tasks evoked differential heart rate responses. There was also a main effect of self-enhancement, $F(1, 84) = 5.80$, $p < .05$. Across the six time periods, high self-enhancers had lower heart rate ($M = 72.84$) than low enhancers ($M = 78.28$). Once again, we obtained the significant Time × Self-Enhancement interaction, $F(5, 420) = 2.73$, $p = .02$. As can be seen in Table 1, this interaction may be understood by the fact that high self-enhancers ($M = 67.51$) and low self-enhancers ($M = 65.08$) did not differ significantly at baseline in their heart rate, $t(90) = 1.31$, $p = .19$, but during the four stress tasks, low self-enhancers had higher heart rate than high self-enhancers; this difference was significant for three of the four stress tasks and a trend for the fourth: counting (87.47 vs. 81.33), $t(90) = 2.11$, $p = .04$; arithmetic (83.17 vs. 75.46), $t(90) = 2.39$, $p = .02$; TAT (80.66 vs. 76.50), $t(90) = 1.56$, $p = .12$; and phrase association (71.81 vs. 67.96), $t(90) = 2.06$, $p = .04$.

Rate pressure product (RPP) analyses. To provide a basis of comparison with Shedler et al.'s (1993) results, we calculated RPP from the heart rate and blood pressure data by multiplying SBP by heart rate and dividing by 100 (Kitamura, Jorgensen, Gobel, & Wang, 1972; Robinson, 1967). RPP is a measure of physiological reactivity that has the advantage of being gender neutral, because women typically show heart rate responses to stress, whereas men typically show blood pressure responses (Allen, Stoney, Owens, & Matthews, 1993; Matthews & Stoney, 1988), but it has the disadvantage of combining cardiovascular indicators with different underlying determinants (e.g., heart rate can reflect parasympathetic

Table 1
The Relation of Self-Enhancement to Cardiovascular Reactivity (RPP), Blood Pressure (BP), Heart Rate (HR), and Neuroendocrine Responses to Stress

	Low self-enhancers			High self-enhancers		
Measure	RPP	BP[a]	HR	RPP	BP[a]	HR
Baseline	74.11	109.61/63.16	67.51	71.01	108.74/62.49	65.08
Counting (7s and 13s)	118.98	134.28/77.79	87.47	105.54*	127.96/76.25	81.33*
Arithmetic	108.89	129.65/75.48	83.17	96.01*	125.58/72.46*	75.46*
TAT	104.05	128.69/75.83	80.66	94.05*	123.44/74.32	76.50
Phrase association	99.65	128.00/74.98	77.26	87.91*	120.31/71.62*	72.46*
Recovery	83.33	115.47/68.86	71.81	75.76*	111.19/65.22*	67.96*

Note. p values are for t-test comparisons between low self-enhancers and high self-enhancers. RPP maximum for low self-enhancers, 132.37; for high self-enhancers, 117.41*; baseline cortisol for low self-enhancers, 0.24; for high self-enhancers, 0.19**. RPP = rate pressure product; TAT = Thematic Apperception Test.
[a] Systolic/diastolic.
* $p < .05$. ** $p < .01$.

as well as sympathetic influences; SBP is affected by alpha-adrenergic vasoconstriction). We calculated RPP for the baseline, counting (average RPP for 7s and 13s), arithmetic, TAT, phrase association, and recovery periods. We submitted the data to a repeated-measures ANOVA with self-enhancement (high vs. low split at the median) as the between-subjects variable and the six time periods as the repeated measure. For 7 participants, physiological measurements for the final rest period were missing; hence subsequent analyses are based on $n = 85$.

The findings were similar to those for heart rate and blood pressure, as would be expected, because RPP is constructed from those indicators. Specifically, there was a main effect of time period, $F(5, 415) = 137.89$, $p < .01$, indicating that the different time periods–tasks evoked differential RPP responses. There was also a main effect of self-enhancement, $F(1, 83) = 7.02$, $p < .01$. Across the six time periods, high self-enhancers had lower RPP ($M = 87.19$) than low enhancers ($M = 98.60$). Of key importance is a significant Time × Self-Enhancement interaction, $F(5, 415) = 3.88$, $p < .01$. As can be seen in Table 1, high and low self-enhancers did not differ significantly at baseline in their RPP, although there is a trend for low self-enhancers to have higher baseline RPP than high self-enhancers. For the four stress tasks, low self-enhancers had significantly greater RPP than high self-enhancers.[2] Looking at the highest RPP response during the stressful tasks reveals that low self-enhancers also had a greater maximum RPP ($M = 132.37$) than the high enhancers ($M = 117.41$), $t(90) = 2.04$, $p < .05$. Moreover, the pattern continued through recovery, when low self-enhancers continued to exhibit a higher RPP than high self-enhancers more than 30 min after the challenge tasks had ended. In summary, consistent with the positive illusions prediction, high self-enhancers showed lower autonomic reactivity to stress than low self-enhancers, not higher stress reactivity as the defensive neuroticism position predicts.

The question arises, however, whether these results indicate that positive illusions about one's personal characteristics are associated with lower autonomic activity to stress and faster recovery or whether merely thinking well of one's personal attributes is associated with these effects. In other words, what evidence is there to suggest that the "illusory" component of high self-enhancement is associated with lower reactivity to stress? To address another purpose of this investigation, we had obtained friends' ratings of participants on the same self-enhancement measure (HSM) that the participants had completed. Ratings made by friends provide a potential validity criterion for the veracity of participants' self-ratings, and they may help to separate out those people who see themselves more positively than others because they are indeed more talented in many arenas than other people from those who simply think of themselves as such (cf. Colvin et al., 1995).

To address this issue, we identified a group of self-enhancers who saw themselves in approximately the same way as their friends saw them and a second group of self-enhancers who saw themselves more positively than their friends saw them. Comparing self-enhancers whose friends saw them in an equivalently positive manner with those who saw themselves as better than their friends regarded them revealed no significant differences on any of the reactivity measures. RPP baseline, RPP during all the stress tasks, and RPP during recovery all revealed that those who saw themselves as better than their friends saw them were actually lower in reactivity ($M = 87.53$, $SD = 18.72$) than those who saw themselves as roughly equivalent to how others saw them ($M = 97.03$, $SD = 15.75$), although none of the differences were significant, $F(1, 32) = 2.58$, *ns*. This trend, however, disappears when one controls for absolute positivity of self-perceptions, suggesting that it is the positivity of one's self-impressions and not whether this concurs with or exceeds evaluations by friends that is accounting for the effects. To summarize, then, the evidence indicates that those who saw themselves in more self-enhancing terms had lower reactivity to stress, and this was the case even among those who saw themselves more positively than their friends regarded them.

Cortisol analyses. We next examined whether there was any evidence that self-enhancement is associated with distinctive HPA axis profiles or HPA axis responses to stress. To assess this issue, we examined log-transformed levels of baseline, stress, and recovery cortisol. It should be noted that the HPA axis may become dysregulated in any of several ways, including elevated HPA axis responses to stress, elevated baseline cortisol, or a flat cortisol response to stress (sometimes in concert with elevated baseline; see McEwen, 1998). Therefore, the cortisol data are not conducive to the Time Period × Self-Enhancement ANOVA technique used for the autonomic reactivity data.

We first assessed whether baseline cortisol responses differed between the two groups and found that high self-enhancers ($M = .19$) had significantly lower baseline cortisol levels than low self-enhancers ($M = .24$), $t(90) = 2.96$, $p < .01$ (see Table 2).[3] This pattern (i.e., low baseline cortisol) is thought to reflect less chronic neuroendocrine reactivity, potentially representing a "healthier" HPA profile (McEwen, 1998) compared with higher levels. We next examined whether the groups differed in stress levels of cortisol and in recovery levels of cortisol. There were no significant differences. Because stress-responsive cortisol profiles potentially prognostic of dysregulation of the HPA axis can assume any of several different forms (McEwen, 1998),[4] we inspected participants' cortisol profiles individually to see if high and low self-enhancers differed in their responses to stress. We did not see any signs of distinctive atypical cortisol responses to stress as a function of self-enhancement, except for the higher baseline among low self-enhancers noted earlier.

Illusory Mental Health and Responses to Stress

As a second assessment of the defensive neuroticism position, we replicated the illusory mental health analytic procedures of Shedler et al. (1993). Following their procedures, we divided the sample of participants judged as distressed or healthy by the

[2] When self-enhancement is looked at continuously, there is also a significant relationship between HSM and the aggregate RPP across the stressful tasks and recovery, $r(92) = -.21$, $p < .05$. Higher self-enhancement is associated with lower RPP.

[3] The continuous measure of self-enhancement is also significantly related to baseline cortisol levels, $r(92) = -.21$, $p < .05$.

[4] As McEwen (1998) noted, HPA axis dysregulation due to long-term exposure to stress and accumulating allostatic load may be evident in any of several different diurnal or stress-responsive cortisol patterns, including hypercortisolism, hypocortisolism (cf. Yehuda, Teicher, Trestman, Levengood, & Siever, 1996), a flat diurnal or stress-responsive profile, and poor recovery following stress.

Table 2
Correlations Among Self-Enhancement, Mental Health–Distress, and Psychological Resources Factors

Measure	1	2	3	4	5	6
1. HSM	—					
2. Mental Health factor	.66**	—				
3. Mental Distress factor	−.53**	−.53**	—			
4. Psychological Resources factor	.71**	.85**	−.74**	—		
5. Clinical rating of mental health (EMT)	−.01	.05	−.24*	.13	—	
6. Judge ratings of mental health (AEMI)	−.06	.03	−.26	.15	.58**	—

Note. HSM = How I See Myself Questionnaire; EMT = Early Memory Test; AEMI = Adelphi Early Memory Index.
* $p < .05$. ** $p < .01$.

clinician into those who scored above or below the median on neuroticism. This procedure identified four groups: genuinely distressed participants (those high in neuroticism and judged distressed by the clinician; $n = 16$), participants who scored high in neuroticism but were judged healthy by the clinician ($n = 27$), genuinely healthy participants (low in neuroticism and judged healthy by the clinician; $n = 35$), and those showing an illusion of mental health (i.e., low in neuroticism but judged as distressed by the clinician; $n = 14$).[5]

Shedler et al. (1993) reported evidence that these clinical ratings of real versus illusory mental health predict differences in autonomic responses to stress, such that those with illusory mental health show greater autonomic reactivity to stress than those who are genuinely healthy. Accordingly, following Shedler et al.'s procedures, we compared the healthy and illusory groups' average RPP across the four stress tasks and maximum RPP. Contrary to Shedler et al.'s results, they did not differ on either average RPP response, $t(47) = .50$, *ns*, or on maximum RPP, $t(47) = .37$, *ns*. We repeated the analyses looking only at RPP during the arithmetic, TAT, and phrase association tasks that Shedler et al. had used; the healthy and illusory mental health groups were not significantly different during these tasks either. None of the cortisol measures (baseline, peak, recovery) discriminated the healthy from the illusory participants. Because Shedler et al.'s sample was predominantly European American, these analyses were repeated separately for the two largest cultural groups, European American and Asian American participants, and there were no differences.[6]

We next repeated these analyses using the student ratings of the EMT protocols on the AEMI. The correlation between the clinician's rating and the aggregated student judge ratings was .58, which compares very favorably with the reliability between students and the clinician in the original Shedler et al. (1993) article. The interrater reliability on the AEMI, the consistency between the clinician ratings and the student judge ratings, and the correlated ratings across two types of judges using two different instruments speaks well for the reliability of these ratings. We repeated Shedler et al.'s procedures using the student judges' evaluations and compared the healthy and illusory groups' average RPP across the four stress tasks and maximum RPP. As was true for the clinician ratings, the groups did not differ.

Mediational Analyses

We next assessed which of three candidates—psychological distress, mental health, and psychological resources—might mediate the effects of self-enhancement on autonomic and HPA functioning. To create mental health–distress composites, means from the 10 scales or subscales conceptualized as mental health outcomes were entered into a factor analysis with promax rotation to allow for correlated factors: the Psychological Health Scales (Ryff, 1989; Ryff & Singer, 1996), specifically, personal growth, autonomy, positive relations with others, purpose in life, and self acceptance; the Beck Depression Inventory (Beck, 1967); the Neuroticism scale of the Eysenck Personality Inventory (S. B. G. Eysenck & Eysenck, 1975); the Spielberger State–Trait Anxiety Inventory (Spielberger et al., 1971); the Cook–Medley Hostility Scale (Cook & Medley, 1954); and the SCL-90-R Brief Symptom Inventory (Derogatis & Spencer, 1982). Two factors accounted for 65.4% of the variance. Factor 1 (Mental Distress) accounted for 50.4% of the variance; its highest loading items were the Spielberger State–Trait Anxiety Inventory (.916), the Brief Symptom Inventory (.871), the Beck Depression Inventory (.844), and the Neuroticism measure of the Eysenck Personality Inventory (.840). Factor 2 (Mental Health) accounted for 15.0% of the variance. Its highest loading items were the Self-Acceptance Scale (.818), the Personal Growth Scale (.788), the Purpose in Life Scale (.755), the Autonomy Scale (.690), and the Positive Relations with Others Scale (.644), all of which are from the Psychological Health Scales (Ryff, 1989). The two factors were negatively correlated, $r(92) = -.53$, $p < .01$.

A set of scales assessed psychological resources: the LOT (Scheier & Carver, 1985); the Rosenberg Self-Esteem Scale

[5] It should be noted that whereas Shedler et al.'s (1993) clinician identified 18 of their low-neurotic participants as distressed and only 9 as healthy, our clinician using the same procedures identified only 14 low neurotics as distressed and 35 as healthy. Put another way, Shedler et al. (1993) identified two thirds of the participants who looked "healthy" on mental health measures as actually "distressed," whereas our clinical consultant, who shared similar training and beliefs about mental health, identified approximately 29% of those identified as "healthy" on standardized measures as "distressed."

[6] We completed a conceptually similar analysis by crossing self-enhancement with the clinician ratings to see if the clinician was able to identify a group of self-enhancers who might be characterized as high in illusory mental health. This procedure identified exactly 1 participant who was high in self-enhancement on the HSM but was identified as highly distressed by the clinician. Although we could not conduct statistical analyses for this 1 person, scores were within the range of the high-self-enhancer/low-distress groups on RPP.

(Rosenberg, 1965); the Pearlin Mastery Scale (Pearlin & Schooler, 1978); the Extraversion scale of the Eysenck Personality Inventory (S. B. G. Eysenck & Eysenck, 1975), the Giving and Receiving Support scale from the MIDI (Brim, 2000); the COPE scale scores (Carver et al., 1989); the Subjective Happiness Scale (Lyubomirsky & Lepper, 1999); and the Work and Community Involvement scales from the MIDI (Brim, 2000). We factor analyzed these resources using a promax rotation, and one main factor emerged accounting for 24.2% of the variance, Positive Resources. Its highest loading items were the Rosenberg Self-Esteem Score (.836), the LOT measure of optimism (.814), and the Pearlin Mastery Scale (.768).

To assess mediation, we conducted a series of regression analyses in which self-enhancement was entered as a continuous predictor with the biological measure as the outcome measure (average RPP and maximum RPP during the stress tasks and baseline cortisol). Then, we entered the potential mediators (psychological distress, mental health, and psychological resources) into the regression and compared the direct and indirect effects of self-enhancement. In the case of the RPP measures, none of the three potential mediators met the criteria for mediation. Self-enhancement was significantly associated with all three potential mediators of psychological distress ($\beta = -.53$, $p < .01$), mental health ($\beta = .66$, $p < .01$) and psychological resources ($\beta = .71$, $p < .01$); however, none of the mediators was significantly associated with either average RPP or maximum RPP.

The regression analysis for baseline cortisol, however, showed a clear mediational pattern via psychological resources (see Figure 1). Specifically, the direct effect of self-enhancement predicting baseline cortisol was significant, $\beta(91) = -.21$, $p < .05$. As noted above, self-enhancement also was associated with psychological resources, $\beta(91) = .71$, $p < .01$. Next, we used both self-enhancement and psychological resources to predict baseline cortisol. The path between psychological resources and baseline cortisol was significant, $\beta(91) = -.40$, $p < .01$, but the direct effect of self-enhancement was no longer significant, $\beta(91) = .07$, *ns*. The Baron and Kenny (1986) modification of the Sobel (1982) test for indirect effects shows that this indirect link is significant ($Z = 2.65$, $p < .01$).[7]

In addition to the pathways outlined above, we examined two alternative causal paths: (a) that positive psychological resources predict baseline cortisol, and this is mediated by self-enhancement; and (b) that baseline cortisol predicts positive psychological resources, and this is mediated by self-enhancement. Neither causal pathway demonstrated evidence of mediation (Baron & Kenny, 1986). Psychological distress and mental health also did not meet the criteria for mediation of the self-enhancement–baseline cortisol relationship. Thus, it appears that the relation of self-enhancement to lower baseline cortisol is mediated by the fact that self-enhancers have more psychosocial resources.

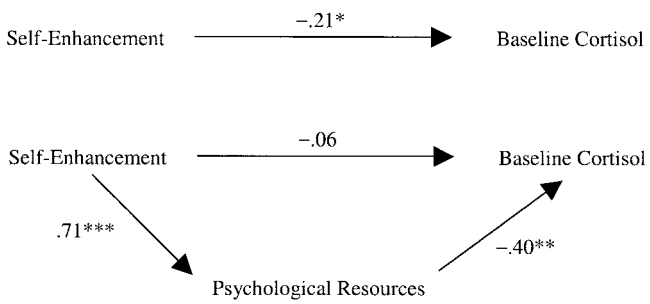

Figure 1. Relationship between self-enhancement and baseline cortisol as mediated by psychological resources. * $p < .05$. ** $p < .01$. *** $p < .001$.

Discussion

We contrasted two views of the potential biological underpinnings of self-enhancement, one of which argues that self-enhancement is a defensive and potentially self-deceptive process that entails physiological costs, the other of which maintains that positive illusions are protective against the biological costs of stress. In support of the positive illusions position, baseline cortisol differences suggest a healthier HPA axis profile for high self-enhancers, and analyses of autonomic responses showed lower levels of arousal among high self-enhancers during the stress tasks as well. These biological results are noteworthy, because they provide the first evidence that positive illusions may be associated with lower autonomic responses to stress and with lower resting HPA axis levels. Moreover, they directly contradict the hypothesis that positive illusions are associated with the defensive denial of negative personal characteristics that may exert physiological costs by virtue of the work entailed by suppression. Instead, they are consistent with a growing body of literature that ties positive mental states, including positive illusions, to healthier physiological and neuroendocrine functioning (e.g., Taylor et al., 2000).

The relation of self-enhancement to autonomic reactivity and baseline cortisol does not in itself speak to the "illusory" aspect of the positive illusions position. That is, positive-illusions researchers have maintained that even when positive beliefs represent a mild distortion of the truth, they may nonetheless be adaptive (Taylor, 1989; Taylor & Brown, 1988). Friends' ratings of the participants provided an opportunity to examine this aspect of the hypotheses as well. Each participant had been rated on the self-enhancement measure by a friend, making it possible to compare people who viewed themselves in a manner similar to how their friends viewed them with those who viewed themselves in a more positive manner than their friends viewed them (cf. Colvin et al., 1995). We found no evidence that those manifesting illusory self-enhancement according to this criterion were higher in autonomic reactivity and baseline cortisol; rather, the evidence suggests a modest but nonsignificant trend in the opposite direction,

[7] The high correlation of self-enhancement and positive resources ($r = .71$) raises potential concerns about multicollinearity. Accordingly, we decomposed the factor and made it more distinct from self-enhancement by removing any scales that correlated with self-enhancement at .60 or better. Next, we examined whether the reformed psychological resources factor would mediate the effects of self-enhancement on baseline cortisol. The additional analysis indicates that it did: Self-enhancement predicted baseline cortisol levels, $\beta(90) = -.21$, $p < .05$; self-enhancement predicted the reformed psychological resources factor, $\beta(90) = .23$, $p < .05$; when positive resources and self-enhancement are entered in as simultaneous predictors, the link between positive resources and baseline cortisol is significant, $\beta(90) = -.23$, $p < .05$, but the indirect link between self-enhancement and baseline cortisol is no longer significant, $\beta(90) = -.15$, *ns.*

largely mediated by the fact that those who saw themselves more positively than their friends saw them were higher in self-enhancement overall. From this pattern of evidence, we conclude that self-enhancement may be a protective resource against autonomic and HPA axis responses to stress, even when that self-enhancement represents a degree of positive illusion.

As a second test of the defensive neuroticism hypothesis, we replicated Shedler et al.'s (1993) procedures designed to identify illusory mental health. To reiterate, they had suggested that some portion of people who score high on self-report measures of mental health are nonetheless unhealthy and maintained that this pattern of poor mental health may be identified through a clinician's evaluations of early memories. In addition, they presented evidence that those identified as having illusory mental health exhibited greater autonomic reactivity to stress than those judged to be genuinely healthy. Although we replicated their procedures, we did not replicate their results. We engaged a clinician with similar training to that of Shedler et al.'s clinician and trained him in the same procedures; he did not discriminate a group of individuals with illusory mental health who had greater autonomic reactivity to stress. We repeated the procedures using a group of student judges trained in the use of the AEMI (Shedler et al., 1995), a means of coding the EMT protocols for judges without clinical training. Again, we found no evidence that these judges could discriminate a group of people high in illusory mental health with corresponding high reactivity to stress. These failures to replicate do not appear to be due to poor reliability or low validity of our clinician or judge ratings: The interrater reliability on the AEMI was extremely high; the clinician's ratings in our study were more highly correlated with ratings made by the student judges using the AEMI rating method than were clinician and student judge ratings in the original Shedler et al. investigation; and the clinician ratings were significantly associated with self-reports of distress (see Table 2). Moreover, to enhance the likelihood that we would replicate Shedler et al.'s results, we had doubled the sample size and added a stressor (mental arithmetic) that typically produces large increases in autonomic activity. Consequently, there is no obvious methodological reason for the nonreplication. The critical point in terms of theory is that our carefully controlled study produced results that are consistent with the positive illusions perspective: Self-enhancement was associated with lower physiological responses to stress and lower baseline cortisol levels.

A potential reconciliation of the positive illusions and defensive neuroticism positions may arise from examining the differing characterizations these positions make about the nature of self-enhancement. The defensive neuroticism position conceptualizes self-enhancement as an enduring aspect of a personality profile marked by self-deceptive, neurotic narcissism that is stably reflected in behavior across time and situations. Positive illusions researchers argue, in contrast, that self-enhancing illusions are situationally responsive. Specifically, self-enhancement may be at low levels when an accurate sense of abilities and resources is needed to meet situational demands (Armor & Taylor, 2003; Taylor & Gollwitzer, 1995) but at higher levels when a person needs to shore up self-esteem and motivation in the face of setbacks or other situational contingencies. Consistent with this point is evidence that positive illusions are more extreme at the general than specific level (Armor & Taylor, 2002), at the beginning of a project than the end of a project (e.g., Shepperd, Ouellette, & Fernandez, 1996), with respect to ambiguous personal qualities than concrete personal qualities with clear behavioral referents (e.g., Dunning, Meyerowitz, & Holzberg, 1989), and when a course of action has been selected than when it is under debate (Taylor & Gollwitzer, 1995). Thus, the flexibility of self-enhancement as a resource may account for its apparently beneficial association with biological stress responses.

The relation of baseline cortisol to self-enhancement is an especially intriguing finding. Baseline cortisol is not a response to concurrent stress but rather reflects the chronic functioning of the HPA system. According to the allostatic load position articulated by McEwen and colleagues (e.g., McEwen & Stellar, 1993; Seeman, Singer, Horwitz, & McEwen, 1997), recurrent or chronic stress can exert cumulatively adverse effects on the body by resetting the baseline and thresholds for different biological regulatory systems, representing the wear and tear exerted on the body by stress over time. Elevated baseline cortisol is thought to be one such indicator, an alteration of HPA axis functioning (McEwen, 1998). Consequently, the negative relation between self-enhancement and baseline cortisol suggests that self-enhancement may have been biologically protective across previous encounters with stress to the degree that its protective effect on HPA axis functioning is enduring.

The relation of self-enhancement to lower baseline cortisol ratings was mediated by psychological resources and not by psychological distress or mental health. It appears that self-enhancement fosters such resources as optimism, mastery, and self-esteem and that these resources, in turn, may foster lower HPA axis activity. Such speculation will require additional confirmation, however. The fact that no mediator of the relation between self-enhancement and autonomic stress responses could be identified was somewhat disappointing. Recall that baseline cortisol reflects the chronic functioning of the HPA system and thereby may be associated with relatively stable resources, whereas the autonomic measures reflect stress responses to the tasks at hand. Had we assessed potential mediators when participants were going through the stress tasks, perhaps a mediational candidate would have emerged.

Additional limitations of the study include the fact that the relations among the variables are correlational, so definitive evidence for causal pathways cannot be identified. However, our tests of alternative causal pathways were nonsignificant, providing strong evidence that self-enhancement fosters lower HPA axis and autonomic activity.

What are the health implications of the present results, if any? In previous research, Taylor et al. (2000) found that HIV-seropositive individuals who held positive illusions about their likely course of illness remained asymptomatic longer and lived longer than those who were more realistic about their condition. In that article, we speculated that enhanced autonomic or HPA axis activity in the less optimistic patients might be one pathway by which immune system downregulation might have occurred. Although the present results do not directly address this complete path, they provide a key link in the hypothesized chain. Specifically, they support the idea that positive illusions may be related to baseline or stress-related autonomic and HPA axis regulation in ways that have implications for health and that they may do so, at least in part, by enabling people to develop and deploy psychological resources.

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Received September 25, 2002
Revision received May 28, 2003
Accepted May 28, 2003 ■