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Look on the bright side: do the benefits of optimism depend on the social nature of the stressor?

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Abstract Growing evidence suggests that a number of personality traits associated with physical disease risk tend to be social in nature and selectively responsive to social as opposed to non-social stimuli. The current aim was to examine dispositional optimism within this framework. In Study 1, optimism was projected into the Interpersonal Circumplex and Five Factor Model revealing significant interpersonal representation characterized by high control and affiliation. Study 2 demonstrated that higher dispositional optimism attenuated cardiovascular responses to a social (speech) but not non-social stressor (cold pressor) task. Optimism-related attenuation of reactivity to the social vs. non-social stressor contributes further evidence to an emerging picture of psychosocial risk as largely reflecting person × *social* environment interactions.

Keywords Interpersonal · Optimism · Pessimism · Stress · Cardiovascular · Social

Compelling evidence supports psychosocial factors as determinants of coronary heart disease development, progression, and morbidity and mortality (Chida and Hamer 2008; Everson-Rose and Lewis 2005; Smith and Ruiz 2002). Research on individual differences and cardiovascular health outcomes has focused on negative dispositions such as hostility, anger, and depressive symptoms as risk factors for cardiovascular disease (Smith et al. 2004; Smith and MacKenzie 2006; Smith and Ruiz 2002). For example, higher levels of hostility are associated with more extensive coronary artery calcification (Smith et al. 2007), cross-sectional association and prospective risk of hypertension (Siegler et al. 1992; Yan et al. 2003), and higher mortality in adults under 60 years (Boyle et al. 2005). One mechanism potentially linking negative dispositions to greater cardiovascular risk is the extent to which these individual differences are associated with stress-mediated cardiovascular responses (Krantz and Manuck 1984; Manuck 1994). It is hypothesized that greater frequency, larger magnitude of change, and longer durations of reactivity may contribute to the development and progression of stress-mediated disease (Kamarck and Lovallo 2003; Krantz and Manuck 1984; Manuck 1994). Research on non-human primates (Manuck et al. 1988), and humans (Barnett et al. 1997; Jennings et al. 2004; Matthews et al. 2006) supports an association between exaggerated cardiovascular reactivity and disease risk (Kamarck and Lovallo 2003; Kamarck et al. 1998; Lovallo and Gerin 2003; Smith and Ruiz 2002; Treiber et al. 2003). For example, hostile individuals display significantly greater blood pressure reactivity during and poorer recovery from laboratory stressors (Christensen and Smith 1993; Rhodes et al. 2002; Suarez and Williams 1990) and higher ambulatory blood pressure and heart rate during periods of negative mood (Räikkönen et al. 1999). Moreover, these responses are prospectively linked to future disease risk (Kamarck et al. 2007; Stewart et al. 2007).

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The bright side of life

In contrast to the abundance of research on negative dispositions, far less is known about these psychosomatic pathways in so-called positive dispositions. Folklore has long espoused the benefits of positive thinking for well-being and health. Recent investigations have begun to provide an empirical basis for this perspective, demonstrating that people reporting greater dispositional positive affect experience better immune functioning, are less susceptible to the common cold, and live longer than those who are less positive (Chida and Steptoe 2008; Doyle et al. 2006; Marsland et al. 2006).

One facet of positivity capturing the idea of "positive thinking" is optimism, a cognitive style associated with having a bias in perceptions in favor of positive features in life (Peterson and Bossio 1991) and having favorable outcome expectancies (Scheier and Carver 1985; Scheier et al. 1994). Optimism can be viewed as state or trait. For example, individuals may be more or less state optimistic depending on the situation (Burke et al. 2000; Peterson and Bossio 1991). Trait or dispositional optimism is a generalized, more consistent positive expectation influencing goal pursuit (Scheier and Carver 1992) and preferred coping responses (Carver et al. 1989). Dispositionally optimistic individuals tend to approach the world in an active manner (Peterson and Bossio 1991) and use cognitive and behavioral efforts to reduce, eliminate, and actively manage demands evoked by a stressor (Carver and Scheier 1998; Solberg Nes and Segerstrom 2006; Suls and Fletcher 1985).

Dispositional optimism is associated with a range of cardiovascular outcomes (Rasmussen et al. 2009). More optimistic individuals are at lower risk of coronary heart disease development (Kubzansky et al. 2001) and experience slower atherosclerotic progression than those who are less optimistic (Matthews et al. 2004). In patients with coronary heart disease, higher optimism is prospectively associated with faster recovery from heart surgery (Contrada et al. 2008; Scheier et al. 1989), lower rates of rehospitalization within 6 months following surgery (Scheier et al. 1999), and better long-term recovery and quality of life after surgery (Peters et al. 2007). Finally, higher optimism is associated with lower cardiovascular and all-cause mortality (Chida and Steptoe 2008; Giltay et al. 2006), and greater longevity (Maruta et al. 2000).

Notably, research on the relationship between dispositional optimism and coronary heart disease risk has been largely epidemiological in nature. Relatively few studies have investigated the relationship between optimism and mechanisms such as cardiovascular reactivity. Those studies that have examined expectancy factors have focused on pessimism as opposed to optimism. Compared to optimistic individuals, pessimists generally anticipate negative outcomes and are more likely to withdraw effort, giving up on achieving goals (Scheier and Carver 1985, 1992). Pessimism is also associated with greater perceived stress and worse self-rated health (Robinson-Whelen et al. 1997) and has been linked to poorer health outcomes (Smith and MacKenzie 2006), including increased illness and mortality (Maruta et al. 2000; Peterson and Seligman 1987). In the sparse mechanism literature pessimism has been associated with greater diastolic blood pressure reactivity in the lab (Williams et al. 1990) and greater overall blood pressure than less pessimistic individuals in a 3 days ambulatory study (Räikkönen et al. 1999).

Is it better to be optimistic or just not pessimistic?

An emerging question within the optimism literature is whether higher optimism confers a health benefit beyond any risk reduction associated with lower pessimism. The Life Orientation Test (LOT), the most frequently used measure of dispositional optimism, was originally developed as a bipolar measure where optimism and pessimism represent two ends of the same continuum (Scheier and Carver 1985). However, factor analyses typically reveal a two-factor structure (Chang and McBride-Chang 1996; Robinson-Whelen et al. 1997). In a recent study, Kubzansky, Kubzansky, and Maselko (2004) examined the one- versus two-factor question using the LOT and confirmatory factor analysis. Results suggest that although the two factors overlap, each explained unique variance in health outcomes. Although Scheier et al. (1994) suggest following up bipolar, total score analyses with the two-factor approach, most of studies do not perform these secondary analyses leaving the question of relative benefit of optimism unanswered. We view this approach as critical to answering the question of whether optimism confers unique health benefits as opposed to simple risk reduction.

The interpersonal approach to psychosocial risk and the nature of laboratory stressors

Does optimism moderate responses to all stimuli or is it specific to a subset of challenges? The interpersonal approach to psychosocial risk factor identification is an emerging framework for understanding personality influences on disease (Smith et al. 2003, 2004). A key aspect of the interpersonal approach is that personality constructs are characterized in terms of their interpersonal attributes (Ruiz et al. 2001) and it posits that personality reflects patterns in social interactions that evoke corresponding physiological responses (such as cardiovascular reactivity) hypothesized to contribute to disease risk. The assumption

of this personality approach has been presented as the *transactional model* (Kiesler 1996; Ruiz et al. 2006; Smith et al. 2003, 2004). In this view, individuals with unique personalities, emotions, cognitions, and goals, reciprocally influence each other in a dynamic process through their outward behaviors and personal experiences. For example, hostility is characterized by a cognitive style that involves an expectation that others are not to be trusted and are out to hurt them. Prior research demonstrates that hostility is characterized by interpersonally cold, unfriendly, and submissive social behaviors (Gallo and Smith 1998; Ruiz et al. 2001). The transactional model predicts that this behavioral pattern will elicit complementary interpersonal responses which reinforce the hostile individual's view of the world as threatening and may further lead to social isolation. Over time, repeated negative interactions contribute to cumulative stress with direct consequences on physical health (Smith and Spiro 2002). Similarly, optimists may expect good intentions from another person, and may have a friendlier approach toward others, who, in turn, will reciprocate and confirm the optimist's positive world view. Prior research on interpersonal correlates of optimism suggests that optimists perceive greater social support, are better liked by others, and tend to have more satisfying and longer-lasting relationships (Assad et al. 2007; Carver et al. 1994; Srivastava et al. 2006), supporting a transactional process.

A consideration in assessing psychosocial risk is the extent to which a potential stressor is salient to the personality construct. In particular, personality traits which are more social in nature may be more responsive to social as opposed to non-social stressors (Smith and Gallo 2001; Smith et al. 2003; Smith et al. 2004). Several studies have demonstrated that hostility is highly social in nature (Smith 1992; Smith et al. 2004). Laboratory investigations using social tasks, such as self-disclosure, evoke greater cardiovascular reactivity and slower recovery among persons high as opposed to low in hostility; however, this difference weakens when the stressor is non-social in nature (Brosschot and Thayer 1998; Smith et al. 2001; Suarez and Williams 1990). Dispositional optimism may function in a similar manner by relating to interpersonal tendencies. As such, dispositional optimism may attenuate cardiovascular reactivity to social as opposed to non-social stressors via positive cognitions and pro-affiliative interpersonal behaviors which may account for some of the protective effects noted in the literature.

Current study

The aim of this research is to examine whether dispositional optimism has more pronounced cardiovascular effects in response to social over non-social stressors. This aim will be examined in two steps. In Study 1 we use a two-factor (Interpersonal Circumplex) and a five-factor model (interpersonal variant of the Five Factor Model) to determine whether dispositional optimism reflects interpersonal attributes. If it is determined that optimism is socially relevant, we will examine whether dispositional optimism is selectively responsive (affect, cardiovascular reactivity) to a social (self-disclosure speech) as opposed to non-social stressor (cold pressor).

Study 1

The first step is to determine the extent to which dispositional optimism (and the underlying optimism and pessimism constructs) is interpersonally relevant and describe its interpersonal characteristics. Two conceptual tools—the Interpersonal Circumplex and the Five-Factor Model have been useful for organizing and comparing personality traits in a common taxonomy. The Interpersonal Circumplex is defined by two principle axes reflecting interpersonal control (dominance to submissiveness) and affiliation (warm, friendliness to cold, hostility). Orthogonal arrangement creates an interpersonal space defined explicitly by social behaviors. Projecting personality traits into this space allows for characterization and comparison in a common nomological net. Similarly, the Five Factor Model has been used as a common conceptual framework for organizing and comparing personality traits on basic dimensions of personality (McCrae and Costa 1987; McCrae and John 1992). A major advancement has been the development and validation of an integrated model (see Trapnell and Wiggins 1990) where the two principle axes of the Interpersonal Circumplex are substituted for the two conceptually similar factors in the Five Factor Model (i.e., Control for Extraversion, Affiliation for Agreeableness). The resulting interpersonal variant of the five-factor taxonomy is particularly useful as a construct validation tool and for integrating the individual difference literature on an interpersonal basis (Ruiz et al. 2001, 2006).

The Life Orientation Test-Revised (LOT-R; Scheier et al. 1994) was projected onto the two-factor Interpersonal Circumplex and the interpersonal variant of the Five Factor Model to provide an interpersonal construct validation (Ruiz et al. 2001). Because optimism is associated with active engagement in managing stressors we expect similar active engagement in interpersonal interactions. Therefore, we hypothesized that dispositional optimism would reflect friendly dominance (high affiliation, high control).

Methods

Participants and procedure

Participants included 496 undergraduates (315 women, 181 men) from a state university. Participants were recruited through the Department of Psychology participant research pool and received course credit for participating. The sample was predominantly white (77.3%) with a mean age of 19.4 (SD = 2.2) years.

Participants completed paper and pencil measures in groups of no more than 20 at a time. At the end of the session, participants are read a debriefing statement that addressed the basic purpose of the study, were given copies of the informed consent, and given credit for participating.

Measures

Dispositional optimism

The LOT-R (Scheier et al. 1994) is a 10-item self-report measure of dispositional optimism. Participants are asked to rate the extent to which they agree or disagree with the statements on a Likert scale (1 = strongly disagree, 5 = strongly agree). The LOT-R contains three positively worded items (e.g., "*In uncertain times, I usually expect the best*") reflecting optimism and three negatively worded items reflecting pessimism ("*If something can go wrong for me, it will*") as well as four filler items. The fillers were omitted from the current study with negligible difference in total score alpha (.75) compared to the 10-item validation paper (.82; Scheier et al. 1994). In addition, the alphas for the subscales were calculated as .65 for the optimism subscale, and .77 for the pessimism subscale.

Interpersonal circumplex and the interpersonal five-factor model

The Revised Interpersonal Adjective Scales–Big Five (IASR-B5; Trapnell and Wiggins 1990) is a 124-item adjective checklist with 64 items used to construct the Interpersonal Circumplex and the remaining 60 items comprising the three remaining traits of the Five-Factor Model (i.e., Neuroticism, Openness to experience, Conscientiousness). Participants rate the extent to which the adjectives describe them using a 5-point Likert rating format ranging from 1 (*extremely accurate*) to 5 (*extremely inaccurate*). The Circumplex can be divided into eight octants reflecting a blend of the two principle axes. Eight items are used to calculate each octant point. Standardized scores are calculated by first computing octant means for the sample and then subtracted from individual participants' octant scores (Trapnell and Wiggins 1990). The scores for control and affiliation are derived from a linear combination of the 64-item, eight-octant scales. The resulting factors for control and affiliation are related to extraversion and agreeableness, respectively, and replace these traits of the Five Factor Model (Trapnell and Wiggins 1990). The remaining 60 items are used to calculate Neuroticism, Openness, and Conscientiousness with 20 items (10 positive, 10 negative) each (Trapnell and Wiggins 1990).

Data analysis

The method outlined by Wiggins and Broughton (1991) and applied to prior measure validations (Gallo and Smith 1998; Ruiz et al. 2001; Smith and Ruiz 2007) is used to examine the associations between the LOT-R and the Interpersonal Circumplex. The first step in this procedure is to characterize the relationship between optimism with the two principle axes of the Circumplex. Two Pearson product-moment correlations are derived which serve as x ($x = r_{vx}$) and y ($y = r_{vy}$) coordinates and allow for locating the optimism in interpersonal space. The Circumplex itself is based on an origin of $r = 0$ with $r \pm 1$ delineating the positive and negative poles of the individual axes. Vector lengths calculated using the multiple correlation for the variable of interest and ranging from a minimum of 0 projecting from the origin to a maximum of 1 characterize the strength of the interpersonal nature of the variable.

There are a variety of methods to examine the association of measures with the Five Factor Model (Gurtman 1997; Trapnell and Wiggins 1990). Here we simultaneously regressed the five predictors from the integrated Five Factor Model (Control, Affiliation, Openness, Neuroticism, Conscientiousness) onto each of the outcome variables (total optimism, optimism, pessimism) separately to examine their independent contributions.

Results

Interpersonal circumplex

All three scales were significantly represented in the Interpersonal Circumplex (Fig. 1). Total optimism and the optimism subscale reflected high control and high affiliation suggesting that individuals higher in optimism have a preferred behavioral style characterized by friendly assertiveness, nurturing, and responsiveness to the needs of others. They are likely to initiate social interactions and do so in a friendly manner. In contrast, the pessimism subscale reflected low levels of control and affiliation suggesting more pessimistic individuals typically prefer to behave in an interpersonally cold and submissive manner, appearing defensive and unapproachable in social contexts.

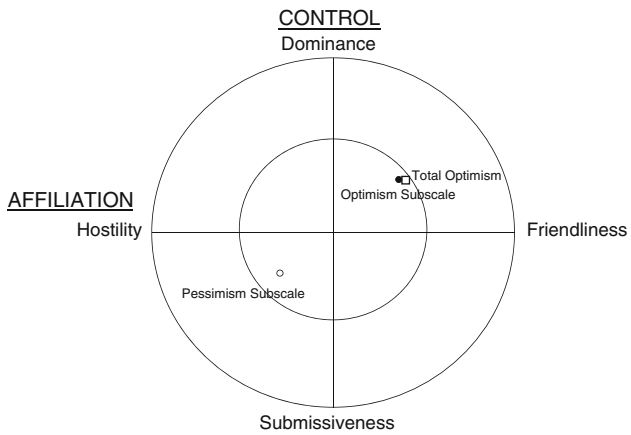

Fig. 1 Projection of the total optimism scale and optimism and pessimism subscales into the Interpersonal Circumplex. Vector lengths are: $VL_{TotOpt} = .47$, $VL_{OptSub} = .45$, $VL_{PessSub} = .39$

Five factor model

Total optimism

As shown in Table 1, the overall *F* for the interpersonal Five Factor Model is significant and accounts for 30% of the variance in total optimism, with control, affiliation, and neuroticism emerging as significant predictors. Higher composite LOT-R scores were associated with higher control and affiliation as well as lower neuroticism suggesting that in addition to friendly dominance, optimists tend not to worry about interpersonal matters. An examination of the squared semi-partial correlations revealed that this element of low neuroticism was the strongest predictor of higher LOT-R scores.

Table 1 Regression of total optimism and optimism/pessimism subscales onto the IASR-B5

Variable	*B*	SE	*β*	sr^2
Total optimism[a]				
Control	1.28	0.34	0.16***	0.03
Affiliation	2.27	0.36	0.28***	0.08
Conscientiousness	0.25	0.29	0.04	0.00
Neuroticism	−2.43	0.28	−0.35***	0.14
Openness	0.44	0.35	0.05	0.00
Optimism subscale[b]				
Control	0.73	0.19	0.17***	0.03
Affiliation	1.28	0.20	0.29***	0.08
Conscientiousness	−0.05	0.16	−0.01	0.00
Neuroticism	−0.97	0.16	−0.26***	0.07
Openness	0.21	0.20	0.05	0.00
Pessimism subscale[c]				
Control	−0.55	0.21	−0.12**	0.01
Affiliation	−0.99	0.22	−0.20***	0.04
Conscientiousness	−0.30	0.18	−0.07	0.01
Neuroticism	1.46	0.17	0.36***	0.13
Openness	−0.23	0.21	−0.05	0.00

* $P < .05$; ** $P < .01$; *** $P < .001$

[a] Multiple $R = .54$; $R^2 = .30$; $F(5, 480) = 40.20$, $P < .001$

[b] Multiple $R = .47$; $R^2 = .22$; $F(5, 480) = 27.39$, $P < .001$

[c] Multiple $R = .49$; $R^2 = .24$; $F(5, 480) = 30.78$, $P < .001$

Subscale analyses

The overall *F* for the interpersonal Five Factor Model solution to the optimism subscale was significant, accounting for 22% of the variance in scores. Like the composite LOT-R score, higher scores on the three-item optimism subscale were predicted by high control and affiliation as well as low neuroticism. However, examination of the squared semi-partial correlates revealed that high affiliation and not low neuroticism was the strongest predictor of high scores. The Five Factor Model was also significant for the pessimism subscale and accounted for a similar amount of variance (24%) as the solution for subscale optimism. The pessimism subscale was characterized by low control and affiliation as well as high neuroticism. Examination of the squared semi-partial correlations revealed that high neuroticism was the strongest predictor of higher pessimism, suggesting that interpersonal worry and concern are the hallmarks of the pessimist in social settings.

Discussion

Study 1 supports dispositional optimism as having social attributes when examined within well-validated interpersonal taxonomies. All three scales were significantly represented in the Interpersonal Circumplex and the interpersonal variant of the Five Factor Model. Consistent with our hypothesis, the total optimism scale and the optimism subscale were characterized by interpersonal control and affiliation, suggesting that individuals high in dispositional optimism are characterized by a preference to actively engage in social interactions and do so in a friendly manner. In contrast, the pessimism subscale reflected a preference to withdraw and maintain distance from others through an interpersonally cold, submissive style. Within the five-factor framework all three constructs reflected interpersonal control, affiliation, and neuroticism. However, examination of the semi-partial correlations revealed important differences between optimism and pessimism where affiliation emerged as the strongest predictor of optimism and neuroticism best predicted pessimism. These findings also contribute to understanding optimism

and pessimism as related but unique constructs as well as prior arguments concerning the relationship between optimism and neuroticism (Smith et al. 1989).

The next phase of the interpersonal approach to psychosocial risk factor identification is to demonstrate that dispositional optimism is associated with health-relevant mechanisms. In the second study we tested the hypothesis that dispositional optimism would attenuate cardiovascular responses to a stress challenge. Like preceding studies of hostility, we expected that a socially relevant construct such as dispositional optimism would be more reactive (i.e., exhibit moderation) to social as opposed to non-social challenges.

Study 2

Participants engaged in two counterbalanced tasks—a non-social foot cold pressor and a social self-disclosure speech task. Affective (anxiety, anger, happiness) and cardiovascular (blood pressure, heart rate) responses were assessed during baselines preceding each task as well as in response to the task and recovery periods. We expected that optimism would moderate responses to the speech task with no moderation to the cold pressor.

Methods

Participants

The sample included 90 undergraduates (44 women, 46 men). The mean age of the sample was 20.4 years (SD = 2.4). The majority of the sample was Caucasian (71.1%) with the remainder self-identifying as Asian/Pacific Islander (11.1%), African-American (6.7%), Hispanic/Latino (5.6%), Native American (1.1%), and other (4.4%). All participants received course credit for their participation.

Measures

Dispositional optimism

The LOT-R (Scheier et al. 1994) without the filler items was used.

State affect and stress

State affect was assessed using a 16-item adjective scale. Following each baseline, cold-pressor task, disclosure task, and recovery periods, participants completed a questionnaire consisting of 16 adjectives rated on a 4-point Likert scale ranging from 1, *Not at all,* to 4, *Very much so*. Twelve items reflected anger and anxiety (Smith et al. 2004). Anxiety was assessed with six items (four negatively valenced: w*orried, tense, nervous, anxious*; two positively valenced: c*alm, relaxed*) drawn from the state anxiety subscale of the Spielberger State-Trait Personality Inventory (STPI; Spielberger 1979). Anger was assessed with four negatively valenced items (*annoyed, angry, irritated, aggravated*) taken from the STPI state anger subscale. Because the original STPI anger scale lacks positively valenced items, two (*friendly, kind-hearted*) were added to provide greater balance (Ruiz et al. 2006; Smith et al. 2004). Finally, state positive affect was assessed with four positively worded items (*happy, joyful, delighted, cheerful*) taken from the joviality subscale on the Positive and Negative Affect Schedule, Extended Version (PANAS-X; Watson and Clark 1994). Alphas for all subscales for all time periods were adequate, ranging as follows: Anxiety (.68 to .86), anger (.67 to .85), happiness (.90 to .93).

Subjective stress was assessed with a single item (*How stressful was this task?*) rated on a 7-point Likert scale ranging from 1, *Not at all stressful*, to 7, *Extremely stressful*.

Physiological data

A Dinamap Pro 100 monitor (GE Medical, Miami, FL) was used to assess systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and heart rate. The Dinamap Pro 100 uses the non-invasive oscillometric method to obtain these physiological measures.

Procedure

Sessions were conducted in two adjoining rooms with designated participant chamber space and a second room for monitoring. Except for brief interactions with the experimenter, participants were alone. Following initial informed consent, participants completed a demographics questionnaire and the LOT-R (Scheier et al. 1994). A blood pressure cuff was placed on the upper portion of the non-dominant arm. All participants completed a minimally involving task or "vanilla" baseline consisting of rating preference among 10 sets of two pictures at a rate of one set per minute (Jennings et al. 1992). Physiological data (blood pressure, heart rate) was collected during the final 3 min and aggregated for an indicator of basal functioning. At the completion of the baseline, participants complete a state affect measure for the first time.

The Study 2 procedures consisted of two counterbalanced tasks that both begin with the "vanilla" baselines and both conclude with a 10-min recovery period. The basic sequence was as follows: "Vanilla" baseline 1 (10-min), task 1 [cold pressor (3-min)], recovery 1 (10-min), "Vanilla" baseline 2 (10-min), task 2 [speech prep (4-min), mental rehearsal (3-min), disclosure speech (5-min)], recovery 2 (10-min). Task order was counterbalanced such that half the participants began with the non-social cold pressor task followed by the social speech task and half began with the social speech task followed by the non-social cold pressor task.

Non-social task

The non-social task consisted of a foot-immersion cold-pressor. A five-gallon bucket containing a mix of ice and water chilled to 4°C was used (Durel et al. 1993; Lovallo 1975; Peckerman et al. 1998). Participants were instructed to immerse their left foot into the mixture for 3 min such that the sole of their foot laid flat on the bottom of the bucket. Blood pressure was sampled at 1 min intervals. At the conclusion of the task, participants rated the stressfulness of the task and completed the measure of state affect. Participants were then instructed to sit quietly during a 10 min recovery period. Heart rate and blood pressure was assessed every other minute. Upon completion of recovery, participants completed the state affect measure for the third time.

Social task

The social task involved giving a self-disclosure speech on a personally embarrassing moment to a video camera with the deceptive caveat that it would be viewed and rated at a later time. An embarrassing moment was used as the speech topic due to its stressfulness and personal relevance and the sharing of such personal information constitutes a significant social challenge. The first step in the procedure involved the participant choosing three embarrassing moments and rating them on a scale of 1 (*not at all embarrassing*) to 7 (*extremely embarrassing*). The experimenter chose the scenario that the participant rated as most embarrassing but was willing to discuss.

The *preparation phase* involved a guided recall procedure to help participants identify specific aspects of the event and to increase emotion induction (Smith et al. 2004). Prompts spaced 45 s apart asked participants (1) to write the basic description of the event, (2) to describe thoughts and emotions they experienced during the event, (3) to describe how they coped with the event, (4) whether they told anyone of the event and how that person responded, and (5) how thinking about the event makes them feel now. No measurements were taken during the preparation phase.

Following the written preparation phase, participants were guided through a 3 min *mental rehearsal* of the event designed to increase emotion induction. Audio-taped prompts guided participants to think about their responses to each aspect of their chosen embarrassing moment. Blood pressure and heart rate measurements were taken at 1 min intervals. Following the tasks participants again completed the state affect measure.

Lastly, participants engaged in the *disclosure task*. The audio-taped prompts guided participants through each of the five aspects of the event at 1 min intervals for the total 5 min speech. Blood pressure was sampled every other minute. At the conclusion of the task, participants again rated their subjective level of stress associated with the task and filled out the state affect measure. Participants were instructed to sit quietly for 10 min while recovery was assessed. Blood pressure and heart rate measurements were taken every other minute followed by completion of the state affect measure for the final time.

Data analysis

Data was cleaned prior to analysis. Frequencies were run for all physiological variables to check for data entry errors and potential outliers at baseline. The first step in identifying outliers was to identify any values outside 2 standard deviations of the group mean for a particular variable (e.g., cold pressor baseline SBP <93 mmHg or >125 mmHg. The second step was to examine the suspect value at the individual participant level. Three readings were taken per participant at baseline. If the suspect value was outside 1 standard deviation of the other 2 values it was treated as missing data. If 2 or more values violated the first step for a single participant than the baseline was deemed uninterpretable and the participant was excluded. No values violated the first step in the identification process. In rare instances, missing values for an individual participant were interpolated within a given epoch (task) by averaging the preceding and following value within a given participant. Otherwise, values were not added. Change scores (i.e., task minus baseline) were calculated for each sampled measure (SBP, DBP, MAP, heart rate, Anxiety, Anger, Happiness) of each task period as per prior recommendations (Llabre et al. 1991). Analysis of variance (ANOVA) was used to examine differences across task period (e.g., baseline, cold pressor, recovery) to determine task effectiveness. Paired-samples *t*-tests and ANOVA were used to determine baseline equivalencies as appropriate.

Optimism effects were analyzed using linear regression. The appropriate baseline term was entered in the first step,

sex was entered in the second step, and total optimism was entered in the third step. Significant total optimism effects were followed up with subscale analyses per the recommendations of Scheier et al. (1994). The appropriate baseline was entered in the first step, sex in the second step, and the optimism and pessimism subscales were entered simultaneously in the third step. In describing the analyses, we report the unstandardized (B), standard error, and standardized (β) regression coefficients. We also report the overall R^2 for the final model and the ΔR^2 for each step.

Results

Baseline equivalence

Baseline equivalences of groups were tested using independent samples t-tests with sex as grouping variable. Compared to women, men had significantly higher SBP (114.6 mmHg vs. 105.3 mmHg) and MAP (85.1 mmHg vs. 82.5 mmHg) during the baseline preceding the cold pressor task and SBP (115.8 mmHg vs. 104.2 mmHg) and MAP (85.4 mmHg vs. 81.8 mmHg) during the baseline preceding the disclosure task, all $ts(87) > 2.50$, $P < .05$. All other baseline physiological indices and state affect measures were statistically equivalent in men and women, $ts(87) < 1.82$, $P =$ NS.

Paired samples t-tests were used to determine overall baseline equivalences between cold-pressor and disclosure tasks. Results reveal that the two baselines did not differ on any physiological or affective measure, all $ts(88) < 1.84$, $P =$ NS (see Tables 2 and 3). Thus, participants were statistically equivalent on measured variables prior to beginning each task. Finally, order effects were examined by repeating the multiple regression analyses for cold pressor and disclosure tasks controlling for order (cold pressor task first versus disclosure task first). No significant order effects were found for either physiological or affective measures.

Task effectiveness

Participants rated the stressfulness of the cold-pressor and disclosure immediately following each task. One-way ANOVA showed no significant sex differences in perceived stressfulness of either task, $F(1, 88) > 2.98$, $P =$ NS. However, paired samples t-test revealed that participants found the cold-pressor to be significantly more stressful than the disclosure task (4.2 vs. 3.6; $t(88) = 2.92$, $P < .01$, 2-tailed). Regression analyses found no significant effects for optimism and perceived stressfulness on the cold pressor task, $R = .09$, $t = -.86$, $P =$ NS, and the disclosure task, $R = .04$, $t = -.38$, $P =$ NS. The aversive nature of the cold pressor task is well-documented (for example, Peckerman et al. 1998; Wolf and Hardy 1941; Wolff 1984). Eight of the 90 participants failed to complete the 3 min trial. One-way ANOVA showed no differences in age, sex, or optimism between completers and non-completers, $F(1, 89) < 1.94$, $P =$ NS.

Cold pressor task

Significant time effects were found for all physiological measures from baseline to cold pressor task to recovery, all $Fs(2, 174) > 94.46$, $P < .001$, partial $\eta^2 > .52$ (Fig. 2, Panel a). Paired samples t-tests revealed that all physiological indices rose significantly from baseline to task and decreased significantly from task to recovery, though recovery values remained significantly elevated over baseline, all $ts(88) > 2.25$, $P < .05$.

Significant time effects were also found for all affect measures from baseline to cold-pressor task to recovery, all $Fs(2, 174) > 18.95$, $P < .001$, partial $\eta^2 > .175$ (Fig. 2,

Table 2 Means and standard deviations for the cold pressor physiological and affect measures

	Baseline	Cold pressor	Recovery
Physiological measures			
SBP (mm/Hg)	109.98*** (8.83)	126.49*** (13.76)	113.48*** (8.92)
DBP (mm/Hg)	66.30* (5.98)	78.29*** (9.30)	67.27*** (5.69)
MAP (mm/Hg)	83.81*** (5.03)	95.33*** (9.11)	85.54*** (4.46)
HR (bpm)	71.07*** (9.68)	79.27*** (13.00)	68.44*** (9.96)
Affect measures			
Anger	8.90 (2.56)	11.29*** (3.89)	9.13*** (2.66)
Anxiety	9.36*** (2.94)	11.98*** (3.51)	8.31*** (2.28)
Happiness	15.71 (4.84)	13.77*** (4.84)	15.36*** (4.75)

Note: Significant differences noted for baseline vs. recovery, cold pressor vs. baseline, recovery vs. cold pressor

* $P < .05$; ** $P < .01$; *** $P < .001$

Table 3 Means and standard deviations for the disclosure physiological and affect measures

	Baseline	Mental rehearsal	Disclosure	Recovery
Physiological measures				
SBP (mm/Hg)	109.99*** (8.26)	115.92*** (9.77)	125.17*** (10.06)	112.74*** (8.64)
DBP (mm/Hg)	65.45*** (4.65)	69.69*** (5.41)	75.50*** (7.21)	67.75*** (5.88)
MAP (mm/Hg)	83.58*** (3.89)	87.27*** (4.84)	93.04*** (6.45)	85.59*** (4.84)
HR (bpm)	71.11* (9.77)	73.38*** (10.72)	77.35*** (11.20)	70.05*** (10.34)
Affect measures				
Anger	8.78 (2.37)	10.30*** (3.32)	9.92 (3.13)	9.03*** (2.75)
Anxiety	9.12* (2.47)	12.39*** (3.89)	11.31* (4.08)	8.28*** (2.47)
Happiness	16.04 (4.56)	13.91*** (4.93)	14.63* (4.93)	15.59* (4.56)

Note: Significant differences noted for baseline vs. recovery, mental rehearsal vs. baseline, disclosure vs. mental rehearsal, recovery vs. disclosure

* $P < .05$; ** $P < .01$; *** $P < .001$

Panel b). Paired samples *t*-tests revealed that the cold pressor task evoked significant increases in anxiety and anger from baseline to task with subsequent decreases from task to recovery (all $ts(88) > 6.70$, $P < .001$). Happiness decreased significantly from baseline to task, $ts(88) > 4.25$, $P < .001$, before returning to baseline levels, $t(88) = 1.53$, $P =$ NS.

Disclosure task

Mean ratings of embarrassment for the events participants chose to discuss were 5.68 (1.28) suggesting moderate to high embarrassment. The disclosure task also evoked significant time effects for all physiological measures from baseline to mental rehearsal to disclosure to recovery, all $Fs(3, 264) > 56.34$, $P < .001$, partial $\eta^2 > .39$. Paired samples *t*-tests revealed that all physiological indices increased significantly from baseline to mental rehearsal, increased significantly from mental rehearsal to disclosure, and subsequently decreased significantly following recovery although levels remained elevated over baseline, all $ts(89) > 2.21$, $P < .05$.

Significant time effects were found for all affect measures from baseline to mental rehearsal to disclosure and to recovery, all $Fs(3, 261) > 14.77$, $P < .001$, partial $\eta^2 > .14$. Paired samples *t*-tests showed that anxiety and anger increased significantly from baseline to mental rehearsal, $ts(89) > 4.83$, $P < .001$. Anxiety significantly decreased from mental rehearsal to disclosure and again decreased from disclosure to recovery, dropping significantly below mental rehearsal, disclosure, and baseline, all $ts(89) > 2.97$, $P < .005$. Anger levels did not change from mental rehearsal to disclosure, $t(89) = 1.49$, $P =$ NS. However, anger did decrease significantly below both mental rehearsal and disclosure following recovery, $ts(89) > 3.64$, $P < .001$, returning to baseline level, $t(89) = 1.37$, $P =$ NS. In contrast to these negative affect effects, state happiness decreased significantly from baseline to mental rehearsal, significantly increased from mental rehearsal to disclosure, and increased further from tasks to recovery, $ts(89) > 3.01$, $P < .005$, returning to baseline level, $t(89) = 1.46$, $P =$ NS.

Together, these findings support the effectiveness of the tasks to evoke stress, assessed as both subjective ratings as well as physiological and affective change.

Dispositional optimism and cold pressor task

Physiological measures

No significant effects were found for total optimism on any of the physiological measures for the cold-pressor task, all $\Delta Fs(1,85) < 1.02$, $P =$ NS.[1] A sex main effect was found for heart rate in response to the cold pressor task, $\Delta F(1,86) = 5.81$, $P < .05$. Specifically, women displayed larger heart rate increases in response to the cold pressor task, $B = 4.74$ (1.97), $P < .05$.

With respect to recovery, no effects involving total optimism were found, all models $\Delta Fs(1,85) < 1.75$, $P =$ NS. A sex main effect was found for SBP following the cold pressor task, $\Delta F(1,86) = 6.20$, $P < .05$. Specifically, men showed a greater decrease in SBP following the cold pressor than women, $B = 2.68$ (1.08), $P < .05$.

Because ratings of embarrassment could potentially influence reactivity, we repeated the multiple regression analyses for the disclosure task and included embarrassment

[1] Because individual differences in emotional styles can influence acute perceptions and responses, we repeated the multiple regression analyses for cold pressure and disclosure tasks controlling for positive (trait positive affect from PANAS) and negative affect (CESD scores, trait negative affect from the PANAS). Inclusion of these basic emotions did not alter outcomes.

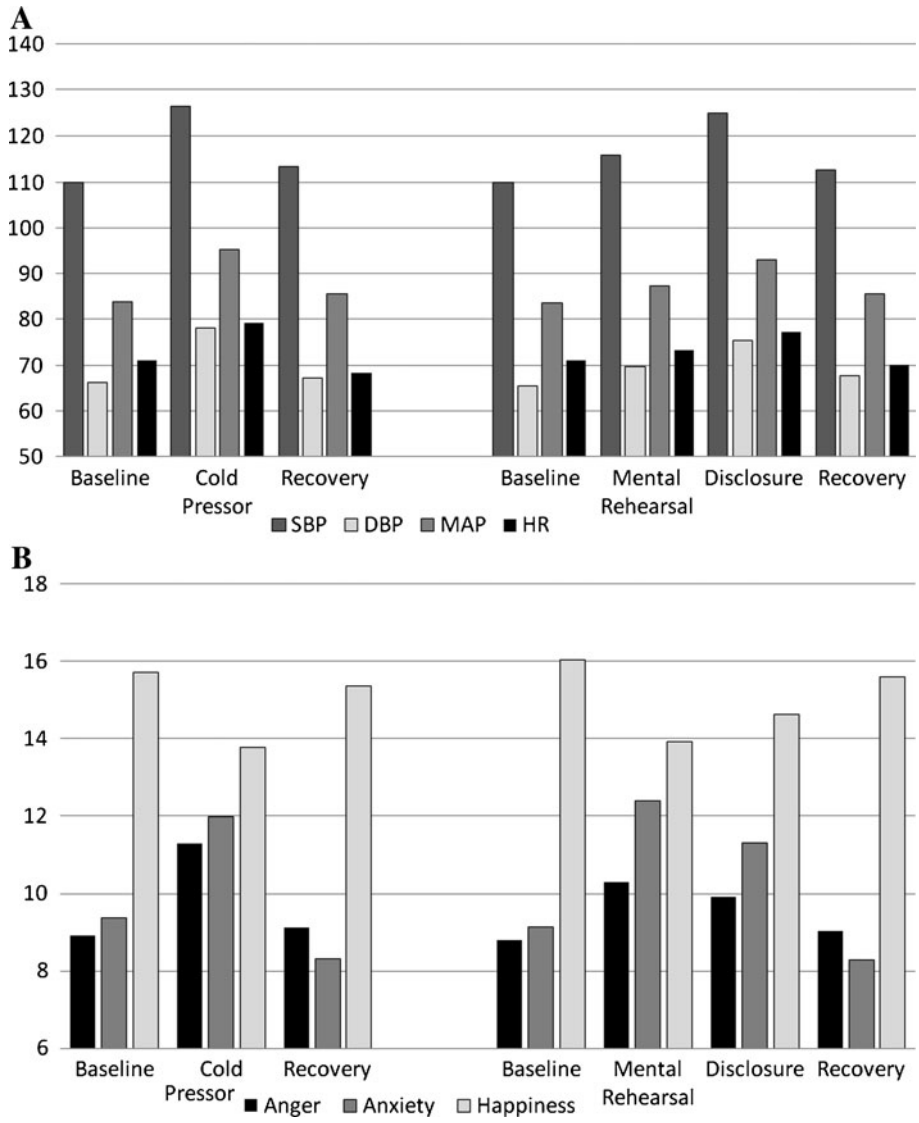

Fig. 2 Task effectiveness for cold pressor and disclosure tasks. Panel **a** displaying magnitude of raw physiological (SBP, DBP, MAP, and HR) and Panel **b** displaying magnitude of affect (Anxiety, Anger, Happiness) in general units for each study period

ratings as a predictor. Inclusion of this variable did not alter outcomes.

Affect measures

A main effect for total optimism was found for anxiety to the task, $\Delta F(1,85) = 4.26$, $P < .05$ (see Table 4). Higher total optimism was associated with an attenuated change in anxiety, accounting for ~4% of the variance. Follow-up analysis revealed that this effect was accounted for by lower pessimism and not higher optimism, $\Delta F(2,84) = 3.80$, $P < .05$. In addition, a sex main effect was found for anxiety to the cold pressor task accounting for ~6% of the variance, $\Delta F(1,86) = 6.37$, $P < .05$. Women reported a greater increase in anxiety during the cold pressor task than men.

Dispositional optimism did not exert any significant effects on affect following the cold pressor recovery period, all ΔFs$(1,85) < 1.50$, P = NS.

Dispositional optimism and disclosure task

Physiological measures

During the mental rehearsal, total optimism exerted a marginal main effect on DBP and a significant effect on MAP. As shown in Table 5, higher total optimism was associated with significantly less MAP reactivity, accounting for ~6% of the variance in MAP change, $\Delta F(1,86) = 4.20$, $P < .05$. Follow-up analysis revealed that this effect was due to higher subscale optimism and not lower pessimism. Higher total optimism was marginally associated with less DBP reactivity, accounting for ~4% of the variance, $\Delta F(1,86) = 3.57$, $P = .06$.

Dispositional optimism did not exert any significant cardiovascular effects during the disclosure task, all ΔFs$(1,86) < 0.50$, P = NS. However, optimism had significant influence on the rate of cardiovascular recovery

Table 4 Multiple regression models for anxiety response to cold pressor task

	B	SE *B*	*β*
Anxiety[a]			
Block 1			
Baseline anxiety	−.58	.11	−.49***
Block 2			
Sex	1.8	.65	.26**
Block 3			
Total optimism	−.17	.08	−.21*
Anxiety[b]			
Block 1			
Baseline anxiety	−.58	.12	−.49***
Block 2			
Sex	2.08	.66	.30**
Block 3			
Pessimism subscale	.43	.16	.31*
Optimism subscale	.12	.18	.08

Note: All coefficient values reflect the final regression model

* $P < .05$, ** $P < .01$, *** $P < .001$

[a] Overall $R^2 = .26$; Block 1 $R^2 = .16$; Block 2, $\Delta R^2 = .06$, $P < .05$; Block 3, $\Delta R^2 = .04$, $P < .05$

[b] Overall $R^2 = .29$; Block 1 $R^2 = .16$; Block 2, $\Delta R^2 = .06$, $P < .05$; Block 3, $\Delta R^2 = .06$, $P < .05$

Table 5 Multiple regression models for physiological responses during mental rehearsal

	B	SE *B*	*β*
MAP[a]			
Block 1			
Baseline MAP	−.07	.08	−.10
Block 2			
Sex	.33	.72	.05
Block 3			
Total optimism	−.15	.08	−.22*
MAP[b]			
Block 1			
Baseline MAP	−.07	.08	−.10
Block 2			
Sex	.14	.73	.02
Block 3			
Pessimism subscale	−.03	.16	−.03
Optimism subscale	−.36	.18	−.27*

Note: All coefficient values reflect the final regression model

[a] Overall $R^2 = .06$; Block 1 $R^2 = .01$; Block 2, $\Delta R^2 = .02$, $P =$ NS; Block 3, $\Delta R^2 = .05$, $P < .05$

[b] Overall $R^2 = .07$; Block 1 $R^2 = .01$; Block 2, $\Delta R^2 = .00$, $P =$ NS; Block 3, $\Delta R^2 = .06$, $P < .06$

Table 6 Multiple regression models for physiological responses during self-disclosure recovery

	B	SE *B*	*β*
SBP[a]			
Block 1			
Baseline SBP	−.16	.06	−.32*
Block 2			
Sex	−1.57	1.24	−.16
Block 3			
Total optimism	−.25	.12	−.22*
SBP[b]			
Block 1			
Baseline SBP	−.17	.06	−.35**
Block 2			
Sex	−2.21	1.24	−.23
Block 3			
Pessimism subscale	−.26	.25	−.13
Optimism subscale	−.81	.28	−.38**
MAP[c]			
Block 1			
Baseline MAP	−.09	.09	−.12
Block 2			
Sex	.07	.73	.07
Block 3			
Total optimism	−.17	.08	−.23*
MAP[d]			
Block 1			
Baseline MAP	−.09	.08	−.13
Block 2			
Sex	−.27	.73	−.04
Block 3			
Pessimism subscale	−.16	.16	−.13
Optimism subscale	−.53	.18	−.38**

Note: All coefficient values reflect the final regression model

* $P < .05$, ** $P < .01$, *** $P < .001$

[a] Overall $R^2 = .09$; Block 1 $R^2 = .03$; Block 2, $\Delta R^2 = .02$, $P =$ NS; Block 3, $\Delta R^2 = .04$, $P < .05$

[b] Overall $R^2 = .10$; Block 1 $R^2 = .03$; Block 2, $\Delta R^2 = .02$, $P =$ NS; Block 3, $\Delta R^2 = .10$, $P < .05$

[c] Overall $R^2 = .06$; Block 1 $R^2 = .01$; Block 2, $\Delta R^2 = .00$, $P =$ NS; Block 3, $\Delta R^2 = .05$, $P < .05$

[d] Overall $R^2 = .11$; Block 1 $R^2 = .01$; Block 2, $\Delta R^2 = .00$, $P =$ NS; Block 3, $\Delta R^2 = .10$, $P < .01$

following the disclosure task. Higher total optimism was associated with significantly faster SBP and MAP recovery (see Table 6), accounting for ~4 and 5% of the variance, respectively, all ΔFs(1,86) > 4.19, $P < .05$. Follow-up analyses revealed that both the SBP and MAP effects were due to higher optimism and not to lower pessimism. In addition, total optimism was marginally associated with a

faster DBP recovery, accounting for ~3% of the variance, $\Delta F(1,86) = 2.85$, $P = .095$.

Affect measures

A marginal effect for total optimism was found for change in happiness during the mental rehearsal, $\Delta F(1,86) = 3.91$, $P < .06$, accounting for ~4% of the variance. Specifically, higher total optimism was marginally associated with a larger increase in happiness. Follow-up analysis did not reveal a significant subscale predictor for this effect, ts < 1.3, $P =$ NS, and no other total optimism main effects on affect were observed during this period, all $\Delta F(1,86) < 1.40$, $P =$ NS.

A similar marginal effect of higher total optimism predicting a larger increase in happiness was also found for the disclosure task, $\Delta F(1,86) = 3.67$, $P < .06$, accounting for ~4% of the variance. Again, follow-up analysis did not reveal a significant subscale predictor for this effect, ts < 1.3, $P =$ NS, and no other total optimism main effects on affect were observed during this period, all $\Delta F(1,86) < 1.40$, $P =$ NS.

Dispositional optimism did not exert any significant effects on affect following the recovery period, all models $\Delta F(1,85) < 2.50$, $P =$ NS.

Discussion

Consistent with expectations, optimism was found to moderate cardiovascular responses to the social as opposed to non-social stress task. In contrast to the cold pressor, higher total optimism was associated with lower blood pressure reactivity while mentally preparing for the interpersonal speech as well as greater blood pressure recovery following the task. Follow-up analyses revealed that these effects were due to higher subscale optimism (i.e., greater positivity) and not lower pessimism. These results support dispositional optimism, particularly higher positivity, as a moderator of acute cardiovascular reactions to and recovery from social stress.

Although there is growing evidence of optimism-related health benefits, there are few studies of potential psychosomatic pathways leading to these outcomes. In particular, there have been very few controlled lab studies examining acute physiological responses to stress. In two studies Räikkönen and Matthews (2008) and Räikkönen et al. 1999a, b) have reported that higher pessimism is associated with greater ambulatory blood pressure during daily life. Study 2 compliments these findings in highlighting the importance of the social context (assumed in ambulatory studies of daily life) to evoking optimism-related effects. However, our results diverge from Räikkönen and Matthews in that we found higher optimism attenuated blood pressure reactivity as opposed to their finding of higher pessimism potentiating blood pressure. We did not find a pessimism effect in our lab investigation. These differences may be due to generalizability constraints of our lab procedure or to differences in stimuli specificity, a social stress task vs. daily life events. Regardless, this study is amongst the first to demonstrate a potential health mechanism advantage to higher optimism as opposed to lower pessimism.

The cognitive nature of optimism may help to understand these buffering effects. Lazarus (1966) and Lazarus and Folkman (1984) posit that cognitive appraisal is a critical mediator of stressful person-environment interactions. Stress appraisal consists of conceptualizing a situation as a challenge or threat and evaluating cost/benefit of coping options to improve chances for a desired outcome (Folkman et al. 1986). Since optimists tend to expect positive outcomes, this would suggest they are inclined to more favorable appraisals (i.e., challenge rather than threat). Results from Study 2 indicate a marginal attenuation of blood pressure reactivity and facilitation of recovery which is suggestive of a reduced vascular pattern of response associated with the appraisal of threat (Tomaka et al. 1997). As a result, dispositionally optimistic individuals may be more resilient to the effects of social stressors, which may explain some of the positive health effects of optimism found in the literature.

General discussion

Optimism-related attenuation of reactivity to the social vs. non-social stressor contributes further evidence to an emerging picture of psychosocial risk as largely reflecting person × *social* environment interactions. Within this framework, socially relevant constructs such as hostility and dispositional optimism selectively moderate (negatively and positively) responses to social stressors. Compelling evidence suggests that hostility-related differences in acute physiological reactivity are evident almost exclusively in response to social stressors. The current research suggests a mirrored effect for a positive disposition where attenuation as opposed to exacerbation is the result. These findings fit with the emerging trend towards the study of individual differences in social phenomenon such as marital interactions and daily life (ambulatory). The interpersonal approach to psychosocial risk factor identification can serve as a particularly useful methodology within this person × social environment framework.

The current findings also further understanding how specific personality traits function to aggravate conflict (as

is the case for hostility) or facilitate social interactions with downstream physiological effects. For example, dispositional optimism is characterized as a cognitive style that involves an expectation for positive future events (Scheier and Carver 1985). Our findings further characterize dispositional optimism within the social context as dominant/friendly suggesting a behavioral preference for active engagement in interpersonal interactions. Through reciprocal determinism (Bandura 1978; Caspi et al. 1989; Mischel and Shoda 1999), optimists influence their interactions through characteristic warm/friendly social behaviors and are influenced by complimentary responses which they helped to shape. Thus, optimists invite positive feedback from the social environment which is positively interpreted, facilitating interpersonal functioning, greater social support, and reinforcing the optimistic person's characteristic thoughts. As demonstrated in Study 2, this interpersonal pattern may attenuate cardiovascular reactivity to and facilitate recovery from social stress, which may account for some of the protective effects noted in the literature.

Qualifications and limitations

Of course, this study is not without significant limitations. The use of college samples and the lab setting itself limit generalizability. It could be argued that the artificial nature of the laboratory affects cardiovascular functioning differently than what would be observed in a more natural setting. Similarly, because the participants are healthy, relatively young, predominantly Caucasian adults, where an insignificant proportion of individuals are prescribed medication for chronic conditions such as hypertension, little information about medical history and medication use was collected. Although participants were asked to refrain from smoking for 2 h and the use of caffeine for 4 h prior to the cardiovascular lab session we did not collect self-report or objective adherence data. It is possible that such violations of the protocol could have affected the results. If this study were extended to include a larger community sample, it would be vital to collect this information. Findings are limited to this particular population, and may differ in persons of different races and/or ethnicities, age groups, and overall health status, including cardiovascular well-being and medication use. Also, information about other potential covariates or confounders (for example smoking, BMI, socio-economic status) that could affect stress response may be important to include in future analyses. In addition, even though the measures used in this experiment are selected for their sound psychometric properties and widely accepted use, different measures may produce different findings. Similarly, the specific tasks selected for Study 2 are commonly used laboratory tasks that were selected to demonstrate reactivity differences to social and non-social stressors; however, these two tasks may differ in terms of other variables that could also affect cardiovascular reactivity. Moreover, although the embarrassment manipulation evoked distress, we did not gather video or other data that would clarify whether embarrassment was the specific emotion evoked. Finally, it may be important to consider other parameters of cardiovascular functioning that have been shown to impact heart disease, such as heart rate variability. Future research should address these issues accordingly.

Conclusions

Despite these qualifications, the present study broadens understanding of dispositional optimism as a social construct. These findings should guide future work to focus on how optimism moderates social stimuli such as peer relations, workplace interactions with coworkers or superiors, and interpersonally challenging or hostile social behaviors of others such as aggression or prejudice. In pursuing these questions researchers should use facet scores to begin answering questions regarding the benefit of optimism vs. reduced risk due to lower pessimism. With respect to health, the interpersonal approach to risk factor identification can be a useful methodology to validate the social correlates of hypothesized psychosocial risk factors and contribute to a more integrated literature.

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