Effects of Optimism, Pessimism, and Trait Anxiety on Ambulatory Blood Pressure and Mood During Everyday Life

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This study tested whether dispositional measures of optimism, pessimism, and anxiety affected ambulatory blood pressure (BP) and mood and whether any cardiovascular effects of dispositions were moderated by mood. Pessimistic and anxious adults had higher BP levels and felt more negative and less positive than did optimists or low anxious adults throughout the monitoring. The few times that optimists did feel negative were associated with levels of BP as high as those observed among pessimists or anxious individuals, regardless of their mood. To the extent that trait anxiety measures neuroticism, these findings suggest that neuroticism is directly related to health indicators rather than simply to illness behavior. Furthermore, the results suggest that pessimism has broad physiological and psychological consequences.

Optimists are people who expect positive outcomes. As a consequence, they expect to cope effectively with everyday stress and challenge, whereas pessimists are those who expect negative outcomes and do not expect to cope successfully (for reviews, see Scheier & Carver, 1985, 1987, 1992). Optimists are likely to persist in their goal-directed efforts, whereas pessimists are more likely to withdraw effort, become passive, and potentially give up on achieving their goals. As such, pessimists are hypothesized to be more likely to experience the physical and emotional consequences of stressful situations than are optimists.

In the past, optimists and pessimists have been classified by high versus low scores on a single dimension and treated as bipolar opposites. Indeed, in most contexts in which they have been studied, the effects of optimism and pessimism have been complementary (Carver et al., 1993). However, more recent research suggests that they are not always two sides of the same coin; for example, they can have different correlates and tend to emerge as separate factors (Mroczek, Spiro, Aldwin, Ozer, & Bosse, 1993; Robinson-Whelen, Kim, MacCallum, & Kiecolt-Glaser, 1997). This issue is not yet resolved, so these findings have led researchers to suggest that the effects of optimism and pessimism be evaluated separately as a matter of course (Scheier, Carver, & Bridges, 1994).

A relative paucity of data exists bearing on whether pessimism and optimism, either as a bipolar trait or as two independent dimensions, lead people to experience different physical health consequences in everyday stressful situations. After coronary bypass surgery, optimists have been shown to recover more quickly from surgery and to have less severe anginal pain than pessimists (Fitzgerald, Tennen, Affleck, & Pransky, 1993; Scheier et al., 1989). Also, optimists have been shown to report fewer physical health complaints than pessimists (Robbins, Spence, & Clark, 1991; Scheier & Carver, 1985; Scheier et al., 1994). Conversely, it has been shown that pessimists tend to display greater diastolic blood pressure (DBP) reactivity to a laboratory stressor (Williams, Riels, & Roper, 1990). In the only study of physical health that examined optimism and pessimism separately, pessimistic cancer patients were more likely to die during the follow-up than their less pessimistic counterparts (Schulz, Bookwala, Knapp, Scheier, & Williamson, 1996). Optimism was unrelated to survival.

Ambulatory blood pressure (BP) is an important physical health outcome. Average ambulatory BP is more closely associated with target-organ damage than are casual measures obtained in clinical

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assessments. For example, ambulatory measurements of BP have been shown to improve the prediction of left ventricular mass (Devereux et al., 1983; Sokolow, Werdegar, Kain, & Hinman, 1966) and cardiovascular mortality (Perloff, Sokolow, & Cowan, 1983). In the present study, we tested the hypothesis that pessimists, as defined by high scores on the Life Orientation Test (LOT; Scheier & Carver, 1985), would experience elevated ambulatory BP throughout the day, even if they were normotensive and in good health. We also evaluated the association of LOT pessimism and optimism subscales separately. In our study, ambulatory BP was assessed approximately every 30 min during waking hours on 2 workdays and 1 nonworkday in 100 normotensive adults. At the time of each BP measurement, participants completed a diary about other possible determinants of BP (e.g., physical activity, posture, and caffeinated beverage intake; Schwartz, Warren, & Pickering, 1994) so that the influences of optimism and pessimism could be examined independent of other common determinants of BP.

Perhaps also relevant to understanding elevations in ambulatory BP is another key disposition, neuroticism or negative affectivity (Watson & Clark, 1984). This refers to a broad, stable dimension of personality consisting of chronic negative emotions, including sadness, anxiety, guilt, and anger. The Spielberger Trait Anxiety Inventory (Spielberger, 1983) is considered a proxy for neuroticism (Smith, Pope, Rhodewalt, & Poulton, 1989; Watson & Clark, 1984), and its scores are highly correlated (r = .73; Watson & Clark, 1984) with scores on Eysenck and Eysenck's (1968) Neuroticism Scale. Trait anxiety scores predicted BP change over time in a sample of healthy middle-aged women (Markovitz, Matthews, Wing, Kuller, & Meilahn, 1991), and a conceptually related score, the Framingham tension score, predicted new hypertension among middle-aged men followed for 18–20 years (Markovitz, Matthews, Kannel, Cobb, & D'Agostino, 1993). To our knowledge, no study in normotensives taking into account the common determinants of BP has evaluated the effect of trait anxiety on ambulatory BP. Therefore, a second study objective was to evaluate whether anxiety, as assessed by the Spielberger Trait Anxiety Inventory, was associated with elevated BP across the monitoring period.

The second objective has theoretical importance because of questions about the discriminant validity of optimism (Smith et al., 1989; cf. Marshall, Wortman, Kusulas, Hervig, & Vickers, 1992). In two studies of healthy undergraduates, high pessimism, as measured by the LOT, and high neuroticism, as measured by the Spielberger Trait Anxiety Inventory, were each related to subsequent reports of frequent minor physical symptoms and problem-focused coping (Smith et al., 1989). Statistical adjustments for trait anxiety rendered nonsignificant the correlations between pessimism and symptoms of problem-focused coping, whereas statistical adjustments for pessimism did not substantially alter the comparable anxiety correlations. This led the investigators to conclude that the relationship between pessimism and symptoms reflect the influence of a predisposition to experience negative affect, or a weaker measure of the general trait. Perhaps this reasoning can also apply to prediction of physical health outcomes, including ambulatory BP. Mroczek et al. (1993) reported that the associations of high pessimism and low optimism with illness severity were each statistically significant, but statistical controls for neuroticism reduced the optimism and pessimism associations to nonsignificance. However, Schulz et al. (1996) reported that depression was not correlated with cancer mortality, whereas high pessimism was, in fact, correlated. Our analytic strategy permitted examining the individual and unique effects of optimism, pessimism, and anxiety on ambulatory BP.

An important determinant of ambulatory BP is mood (Schwartz et al., 1994), and both optimism–pessimism and anxiety are correlated with mood states. In general, optimists are in a more positive mood, whereas pessimists are in a more negative mood (Marshall et al., 1992; Scheier et al., 1994). For example, pessimistic women have been shown to report higher levels of depressive symptoms than optimistic women (Marshall & Lang, 1990), especially in the presence of stressful ongoing problems (Bromberger & Matthews, 1996) or after a stressful life change (Carver & Gaines, 1987). Low optimism, but not high pessimism, has been correlated with reports of daily hassles (Mroczek et al., 1993). In general, individuals high in neuroticism are in a more negative mood than are those low in neuroticism. For example, it has been shown that neurotic students report increases in daily anxiety as they approach a major examination (Bolger, 1990) and that neurotic undergraduates report more daily depressive and gastrointestinal symptoms across 2 months than their less neurotic counterparts (Larsen & Kasimatis, 1991). Some evidence suggests that neuroticism is more highly correlated with high negative mood than with low positive mood (Larsen & Ketelaar, 1991). Neuroticism is associated with high exposure to daily stressors, with interpersonal conflicts being the most important daily stressor in explaining the neuroticism–distress relationship (Bolger & Schilling, 1991). A third objective of the present study was to extend these findings by examining mood ratings made simultaneously with the BP readings in light of the dispositions of the study participants and to explore whether any obtained associations between dispositions and ambulatory BP might be moderated by changes in negative mood. Frequent measurement of mood states during participants' usual daily activities provides different information than a single measurement of current mood during extraordinary or artificial circumstances or a single summary measure of mood taken each day. We expected pessimists and neurotics to report more negative mood and experience more frequent negative interpersonal interactions, and we expected optimists to report more positive mood. The analytic strategy again allowed testing for the individual and unique effects of each personality variable.

Method

Participants

One hundred participants (50 women and 50 men) between 30 and 45 years of age (women: M = 37.1 years, SD = 4.1; men: M = 36.5 years, SD = 4.7) were recruited from a university community setting. Eighty-eight percent of the participants were Caucasian, and 10% were African American. Half of the participants were employed in professional or managerial jobs, and the other half worked in technical or clerical positions; men and women were matched in terms of their level of occupational prestige. All participants worked more than 20 hr per week and were employed during daytime hours. A telephone interview screened potential participants to ensure that they did not smoke, were free of chronic disease (including hypertension), were less than 20% overweight, and were not taking medications with known cardiovascular or metabolic effects (hormone replacement or contraceptives). Additional eligibility criteria included resting (laboratory) BP assessments in the normal range (systolic

BP [SBP]: ≤140 mmHg; DBP: ≤90 mmHg). Table 1 provides demographic and other data on the men and women in the study.

Procedure

Each participant was involved in 3 days of ambulatory monitoring. The monitor was worn on 2 working days from 8:00 a.m. to 10:00 p.m. and on 1 nonworking day from 10:00 a.m. to 6:00 p.m., with BP recorded at 30-min intervals. Measurement on both working and nonworking days allowed broad sampling of daily experiences at home and at work. Each time the cuff deflated, the participants completed a page in an ambulatory diary designed to measure concurrent behavioral and psychological states.

Before the ambulatory monitoring, all participants attended an assessment session in the laboratory. At the initial visit, participants were briefed concerning the protocol, and informed consent was obtained. At this point of the protocol, resting BP levels, height, and weight were measured in the laboratory, and demographic information was gathered. BP was measured with an automated BP monitor (IBS Model SD-700A). Participants then completed a battery of psychological questionnaires and participated in interviews providing data on a variety of personality characteristics. After the assessment procedure, participants were trained in the use of the ambulatory BP monitoring device and the diary. That is, participants were trained and provided written instructions on (a) how to take the monitor off and (b) the correct placement of the microphone and the BP cuff. They were also trained on how to change the battery of the monitor. A sample BP reading was taken at this time, and participants completed a page in the diary. Participants then left the laboratory and, within the next week (unless their work schedule did not permit it), wore the monitor for 3 days (2 working days and on 1 nonworking day). If participants were not working the next 2 consecutive days, the measurement period continued into the following workweek. At the end of each of the 3 days, the participants were asked to complete an "end-of-day" assessment in the diary, including their psychological and behavioral states while wearing the monitor on that particular day.

After wearing the monitor for 3 days, participants returned to the laboratory for a second assessment session. During this session, they completed the remainder of the questionnaires and interviews not administered at the first session as a result of time constraints. After the second assessment session, any questions the participant had about the study were answered. Participants were then paid $100 for taking part in the study.

Table 1
Demographic, Psychological, and Health Characteristics of the Sample

Characteristic	Women			Men		
	n	*M*	*SD*	*n*	*M*	*SD*
Age (years)		37.1	4.1		36.5	4.7
Occupational prestige (Hollingshead index score)		51.1	10.1		50.4	10.0
Body weight (kg)		64.3	9.9		79.2	11.0
Body mass index (kg/m^2)		24.2	3.3		25.7	3.1
Overall optimism score		5.8	4.6		5.9	4.8
Below median (≤5)	29			27		
Above median (>5)	21			23		
Pessimism subscale		2.1	2.5		2.5	3.1
Below median (≤2)	17			18		
Above median (>2)	33			32		
Optimism subscale		8.3	2.7		8.6	2.3
Below median (≤8.5)	25			25		
Above median (>8.5)	25			25		
Trait anxiety		16.6	4.6		15.7	4.7
Below median (≤15)	22			23		
Above median (>15)	28			27		
Ambulatory systolic blood pressure (mmHg)		116.0	14.7		124.8	14.4
Ambulatory diastolic blood pressure (mmHg)		67.7	10.4		73.4	10.2
Mood ratings						
Negative		9.2	2.1		9.2	2.2
Positive		14.4	3.6		14.1	3.7
Bored		3.8	1.0		3.8	1.0
Negative interpersonal interaction		0.1	0.3		0.1	0.3

Measures

Diary of mood and events. The ambulatory diary, designed to measure behavioral and psychological states with potential influences on cardiovascular activity, was adapted from the diary developed by Hedges, Krantz, Contrada, and Rozanski (1990) for monitoring ambulatory physiological states and mood. The participants responded to 17 words describing their current mood state (e.g., stressed, angry, happy, or tired) on a 4-point scale ranging from *not at all* (1) to *a lot* (4). In the present study, the averages of the 75 diary entries for each of the 17 mood states were subjected to principal-components factor analysis followed by varimax rotation. Three factors with eigenvalues above 1 (4.4, 2.3, and 1.3) accounted for 47.1% of the variance. A scree plot of factor roots was consistent with the extraction of three factors. The first factor consisted of high positive loadings for stressed, irritable, angry, resentful, nervous, worried, impatient, and sad and was labeled "negative mood." The second factor consisted of high positive loadings for pleased, happy, content, energetic, in control, and interested–involved and was labeled "positive mood." Finally, the third factor consisted of high positive loadings for bored, apathetic, and tired and was labeled "bored."[1] The items loading on each factor were unit weighted and summed for each of the 75 data collections to designate periods of negative, positive, and bored mood during ambulatory monitoring. Cronbach alpha coefficients for the negative, positive, and bored mood scales, as averaged across the 75 data collections, were .88, .87, and .50, respectively. Total scores were used rather than single items because of the increased reliability of measurement (cf. Hedges et al., 1990), the factor structure underlying the 17 items, and the desire to avoid Type 1 error.

The diary also included information regarding the circumstances under which the mood and BP assessments were made. Participants indicated their location (home, work, or driving a car), posture (reclining, sitting, or standing), physical activity level (low, mild, moderate, or strenuous), substance use (alcohol, caffeine, or "over-the counter" medications), interpersonal social interaction (yes or no), and the type of interpersonal interaction (positive, neutral, negative, or an argument) at the time of the reading.

The "end-of-day" assessment in the diary included information regarding mood; the participants responded to the same 17 mood states that they had rated throughout the day. However, they were instructed to respond to these mood items in terms of how strongly they felt each mood during that day. They were also asked to record the most stressful or difficult event that had happened to them while wearing the monitor that day and to rate the severity of the event on a 4-point scale ranging from *very mild* (1) to *very severe* (4).

Cardiovascular measures. BP was assessed outside the laboratory

[1] Separate factor analyses were run for the mood ratings of men and women. Three factors with eigenvalues above 1 emerged on both groups, the factors being substantively identical with the overall factor analysis. Therefore, designation of periods of negative, positive, and bored moods for women and men across the days of monitoring according to positive loadings on the overall factor analysis was deemed valid.

environment with the Colin ABPM-630 ambulatory monitor. This monitor has the major advantage of using a silent CO_2 cartridge in cuff inflations rather than an inflation pump that can produce varying degrees of noise. Such a measurement may be less noticeable to others and, therefore, less likely to cause participants to deviate from their normal behavior patterns (Matthews, Owens, Allen, & Stoney, 1992). The BP cuff (child, adult, or large adult size) was placed on the participant's nondominant upper arm and positioned so that the microphone was over the inner aspect of the arm. The Colin monitor allows for both auscultatory (detected via microphone) and oscillometric determinations of BP. Oscillometric values were used in favor of auscultatory ones because this measurement technique is less prone to contamination if the microphone is not precisely mounted on the artery, and thus it serves as a more reliable estimate of ambulatory BP. In addition, the oscillometric method produced less missing data than the auscultatory method.

Dispositional optimism. Dispositional optimism was assessed via the LOT (Scheier & Carver, 1985). The LOT consists of eight items (along with three filler items), of which four are worded positively (in the optimism direction) and four are worded negatively (in the pessimism direction). With this scale, respondents indicate to what degree they endorse statements such as "I rarely count on good things happening to me" on a scale ranging from 0 (*strongly disagree*) to 3 (*strongly agree*). After the positively worded items had been reversed, the eight items were totaled to yield an overall optimism score, with high scores indicating low optimism (high pessimism). In addition to the overall score, the positively and negatively worded items were totaled separately to yield optimism and pessimism scores. The two-dimensionality of the LOT was verified by principal-components factor analysis with varimax rotation. Indeed, the analysis yielded two factors with eigenvalues greater than 1 (3.90 and 1.36), these factors explaining 66% of the variance. The first factor consisted of high positive loadings of the negatively worded items, and the second factor consisted of high positive loadings of the positively worded items (cf. Marshall et al., 1992; Scheier et al., 1994). Cronbach alpha coefficients for the overall score and for the optimism and pessimism subscale scores were .84, .75, and .86, respectively (cf. Scheier & Carver, 1985; Scheier et al., 1994).

Trait anxiety. Trait anxiety was assessed with the 10 items from the Spielberger Trait Anxiety Inventory (Spielberger, 1983). Respondents indicated how they "generally" felt by endorsing statements such as "I feel nervous and restless." Endorsements were made on a scale ranging from 1 (*almost never*) to 4 (*almost always*). The items were totaled to yield an overall anxiety score, with high scores indicating high trait anxiety. Cronbach's alpha coefficient was .86 in the present sample (cf. Spielberger, 1983).

Data Reduction

Cardiovascular measures. Approximately 16% of the readings (1,223 of 7,500) were missing because of problems with the monitor or because the participant failed to wear the monitor during the predetermined times. Additional readings were excluded based on criteria developed in our laboratory for assessment of BP in normotensive, healthy populations. Twenty-one readings were excluded because (a) DBP was greater than 140 mmHg or less than 40 mmHg or (b) pulse pressure (i.e., the arithmetic difference between SBP and DBP) was less than 15 mmHg. Forty-two SBP readings below 80 mmHg and 3 SBP readings above 200 mmHg were excluded because the questionable BP was greater or less than 2 standard deviations of the participant's average BP and inspection of physical activity or posture (as indicated in the ambulatory diary) could not explain an unusually high or low SBP. It should be noted that if any of these exclusion criteria were met, all data for a particular point in time were excluded. That is, if a DBP reading was greater than 140 mmHg, the corresponding SBP data were also excluded from the analyses. Thus, an average participant produced 62 (SD = 6.81) valid BP readings, the data overall consisting of 82.8% (6,211 of 7,500) of valid observations.

Diary of mood and events. An average participant missed fewer than 3.1% (SD = 3.2) of the mood observations and fewer than 2.6% (SD = 2.8), 1.8% (SD = 2.4), 2.5% (SD = 3.3), 2.4% (SD = 3.2), 3.4% (SD = 3.5), and 2.0% (SD = 2.2) of the observations on location, posture, physical activity, substance use, interpersonal interaction, and type of interpersonal interaction, respectively. Of the ambulatory diary observations, 85.3% (6,397 of 7,500) were available for the study. Altogether, 97.4% (6,050 of 6,211) of the ambulatory BP readings had a simultaneous daily diary observation available. There were no differences between optimists and pessimists or between individuals high and low in trait anxiety in the extent to which either mood or BP values were missing.

Statistical Analyses

To meet the specific research questions and to benefit from the experiental sampling method, we used a statistical approach combining both the idiographic and nomothetic levels of analysis. Therefore, in addition to simple descriptive statistics and within-subject correlations, random regression models (PROC MIXED; SAS Institute) were used to analyze the data. Indeed, the random effects approach yields regression estimates for each individual (on a within-subject basis) and for the group as well. The analysis requires no equality of slopes and intercepts of all variables across the sample and allows different error structure assumptions (including autocorrelation effects between adjacent residuals).

Before proceeding to the study hypotheses, we determined which of the potential covariates measured in the ambulatory diary predicted SBP and DBP. In these analyses, repeated BP readings were used as the dependent variables in separate models. Physical activity, posture, location, substance use (alcohol, caffeine, "over the counter" medications), and interpersonal social interaction (yes/no; all dummy coded), measured concurrently with BP, served as time-varying (within-subject) covariates in each model. Thus, our analysis determined, on a within-subject basis, the extent to which momentary changes in BP were attributable to momentary changes in physical activity, posture, location, substance use, and interpersonal interaction. Each model also included gender and level of occupational prestige (dichotomized according to Hollingshead index score) as covariates varying between subjects. We also examined the individual and unique effects of negative, positive, and bored moods and perceived negativity of interpersonal interaction on BP.

After the analyses determining the covariates of ambulatory BP, we carried out random regression analyses determining the individual and combined effects of dispositional optimism and trait anxiety on BP, along with their interactions with negative mood. In addition to conducting separate analyses for SBP and DBP, we conducted separate analyses to determine the individual and combined effects of overall optimism, optimism and pessimism subscales, and trait anxiety on cardiovascular activity. With the within-subject, time-varying covariates, gender, and level of occupational prestige in the model, personality measure, negative mood, and their interactions were entered. The personality measure, dichotomized with men and women combined, served as a between-subjects variable in the model, whereas the ratings of negative mood varied within subjects. Separate slopes and intercepts were computed for individuals scoring above and below the median on overall optimism, on the optimism and pessimism subscales, and on trait anxiety, and contrast comparisons were computed to examine whether the within-subject effects of negative mood on cardiovascular activity varied between the two groups.

The second major goal of our study was to test the individual and unique effects of dispositional optimism and anxiety on ongoing states of mood. Negative, positive, and bored moods and type of interpersonal interaction (0 = *neutral* or *positive,* 1 = *negative interaction* or *an argument*) were analyzed in separate models, as were the effects of overall optimism, the optimism and pessimism subscales, and trait anxiety.

We used the maximum-likelihood estimation method and set up the covariance matrix corresponding to the random effects in the model (i.e.,

variance components), assuming complete independence across the participants. The within-subject residual covariance matrix was modeled according to the first-order autoregressive errors. That is, the participant's response at a given time point was assumed to be predicted by his or her response at the adjacent time point and to a much lesser degree by a more distal response. In each model, the average within-subject serial correlation of residuals was substantial and significant ($ps < .001$ for all correlations).

Results

Table 1 presents the mean values for the primary variables. None of the dispositions varied by gender or level of occupational prestige ($ps > .10$). The Pearson correlation coefficients were .53 between overall optimism score and trait anxiety and −.50 and .44, respectively, between the optimism and pessimism subscales and trait anxiety ($ps < .001$). The subscale scores were also significantly related to one another ($r = -.47$, $p < .001$).

As reported elsewhere (Räikkönen, Matthews, Flory, & Owens, 1999), the within-subject correlations (Michela, 1990) between mood and negative interpersonal interactions showed that the more negative the participant's mood, the less positive she or he felt ($r = -.36$, $p < .001$) and the greater the concurrent negativity of interpersonal interactions ($r = .56$, $p < .001$). The more positive the participant felt, the less she or he felt bored ($r = -.32$, $p < .01$) and the less negative the concurrent interpersonal interaction ($r = -.30$, $p < .01$). Correlations of bored mood with negative mood ($r = .03$) and negative interpersonal interactions ($r = .04$) were nonsignificant.

Covariates of Ambulatory Blood Pressure

The results of the random regression models testing the effects of posture, location, physical activity, substance use, and interpersonal interaction are reported in Table 2. Analyses showed that posture, location, and physical activity were consistently significantly associated with SBP and DBP, with SBP being higher when the participant was engaging in moderate or strenuous exercise, driving a car, and sitting or standing. DBP was higher when the participant was sitting or standing. Use of alcohol had an effect on SBP only, whereas use of over-the-counter medications, caffeine, and interpersonal interaction had no effects. Furthermore, men had higher average SBP and DBP than women, but level of occupational prestige had no effects on BP. The subsequent random regression models were conducted with location, posture, and physical activity as covariates varying within subjects and gender and occupational prestige as covariates varying between subjects.

The analyses testing the effects of moods and negative interpersonal interaction on BP are reported in Table 2. Negative mood was associated with elevations in SBP, positive mood was associated with elevations in SBP and DBP, and boredom was associated with attenuated SBP and DBP. Negative interpersonal interaction had no cardiovascular effects.

Influence of Dispositional Optimism, Trait Anxiety, and Mood on Ambulatory Blood Pressure

Individual effects of traits. The effects of traits taken individually are presented in Table 3. Pessimists (according to overall LOT score) had significantly higher average SBP and DBP levels than optimists. This pattern was replicated with the optimism subscale but not with the pessimism subscale.

Table 2
Predictors of Ambulatory Blood Pressure

Variable	Systolic blood pressure		Diastolic blood pressure	
	Estimate	*p*	Estimate	*p*
Physical activity (vs. low)				
Mild	0.44	.27	0.06	.83
Moderate	3.39	.002	−0.59	.42
Strenuous	9.48	.006	3.47	.09
Location (vs. home)				
Work	0.86	.09	0.57	.10
Driving	1.74	.02	−0.55	.29
Posture (vs. reclining)				
Sitting	8.52	.0001	6.62	.0001
Standing	12.23	.0001	7.72	.0001
Alcohol (yes vs. no)	4.37	.03	2.41	.11
Caffeine (yes vs. no)	−0.05	.93	0.14	.74
Over-the-counter medication (yes vs. no)	7.35	.15	1.83	.32
Interpersonal social interaction (yes vs. no)	0.46	.25	0.53	.06
Women (0) vs. men (1)[a]	−8.37	.0001	−5.71	.0001
Low (1) vs. high (0) job status[a]	1.25	.39	1.08	.28
Negative mood[b]	0.34	.009	0.09	.35
Positive mood[b]	0.15	.05	0.25	.0001
Bored mood[b]	−0.45	.02	−0.48	.006
Negative interpersonal interactions[b]	1.04	.15	0.49	.31

[a] Estimate reflects a difference between the groups. [b] Effect estimated with physical activity, location, posture, gender, and occupational prestige in the model.

The analyses testing the effects of mood on ambulatory BP indicated that pessimists (as indicated by overall LOT score) showed equivalent BP, regardless of the presence or absence of negative mood: SBP, estimate = .20, $t(5267) = 1.53$, $p = .13$, and DBP, estimate = −.10, $t(5267) = -1.07$, $p = .29$. In contrast, only when in a negative mood did optimists (as indicated by overall LOT score) show elevations in SBP, estimate = .44, $t(5267) = 2.80$, $p = .005$, and DBP, estimate = .32, $t(5267) = 2.83$, $p = .005$ (see Figures 1 and 2). Contrast comparisons between optimists and pessimists assessed by the overall LOT were not significant in the analysis of SBP, $F(1, 5267) = 1.46$, $p = .23$, but were significant in the analysis of DBP, $F(1, 5267) = 8.33$, $p = .004$. An identical pattern of significant results was obtained in the analyses classifying participants via the pessimism and optimism subscales.

Table 3 shows that individuals with high scores on the Spielberger Trait Anxiety Inventory had significantly higher average SBP and DBP levels than individuals with low scores. The BP levels of those with high trait anxiety scores were unaffected by negative mood: SBP, estimate = .07, $t(5267) = .52$, $p = .60$, and DBP, estimate = −.16, $t(5267) = -1.70$, $p < .09$. Conversely, the BP levels of those with low trait anxiety scores were elevated at times of negative mood: SBP, estimate = .58, $t(5267) = 3.87$, $p < .001$, and DBP, estimate = .36, $t = 3.32$, $p < .001$. Contrast comparisons of the slopes between individuals with low and high anxiety scores were significant in the analyses of both SBP, $F(1,$

Table 3
Average Ambulatory Blood Pressure Across 3 Days in Optimists, Pessimists, and Anxious Participants

Measure	Systolic blood pressure			Diastolic blood pressure		
	M	Unadjusted *p*	Adjusted *p*[a]	*M*	Unadjusted *p*	Adjusted *p*[a]
Dispositional optimism						
Overall score		.04	.12		.002	.01
Low (optimism)	118.5			67.3		
High (pessimism)	123.2			72.3		
Pessimism subscale		.10	.26		.16	.38
Low	116.3			68.8		
High	119.9			71.0		
Optimism subscale		.04	.12		.005	.02
Low	119.9			72.1		
High	115.3			67.7		
Trait anxiety		.001	.006		.0001	.0003
Low	114.2			66.7		
High	121.4			73.0		

[a] Adjusted for anxiety–optimism.

5267) = 6.63, $p < .01$, and DBP, $F(1, 5267) = 13.17$, $p < .0003$ (see Figures 3 and 4).

Because dispositional optimism and trait anxiety may interact with other moods or situational factors in determining BP, we tested interactions of the dispositions with positive and bored mood, interpersonal interaction, negative interpersonal interaction (positive–neutral vs. negative–conflict), and home versus work location. The results of these analyses showed no significant interactions for overall LOT score, LOT subscale scores, or Spielberger Trait Anxiety Inventory scores ($p > .07$).

Unique effects of traits. The analyses examining the independent effects of optimism and trait anxiety on BP demonstrated that the main effects of the overall LOT and the optimism subscale scores were nonsignificant in the analyses of SBP after adjustment for trait anxiety ($ps > .12$). The effects on DBP remained significant ($ps < .02$) and showed that pessimists (as indicated by overall LOT score) and low optimists (according to the optimism subscale) had higher DBP levels than their counterparts. Statistical controls for overall LOT score or for optimism and pessimism subscale scores (data not shown) did not alter the associations between trait anxiety and BP ($ps < .01$).

Influence of Dispositional Optimism and Trait Anxiety on Mood and Perceived Negativity of Interactions

Individual effects of traits. Table 4 shows that pessimists (according to overall LOT score) reported higher negative mood, lower positive mood, and more frequent negative interpersonal interactions than did optimists ($ps < .03$). Individuals with high scores on the pessimism subscale felt more negatively and reported more frequent negative interpersonal interactions than individuals with low pessimism scores ($ps < .002$). Individuals with high optimism subscale scores felt less negatively, experienced fewer negative interactions, and felt more positively than individuals

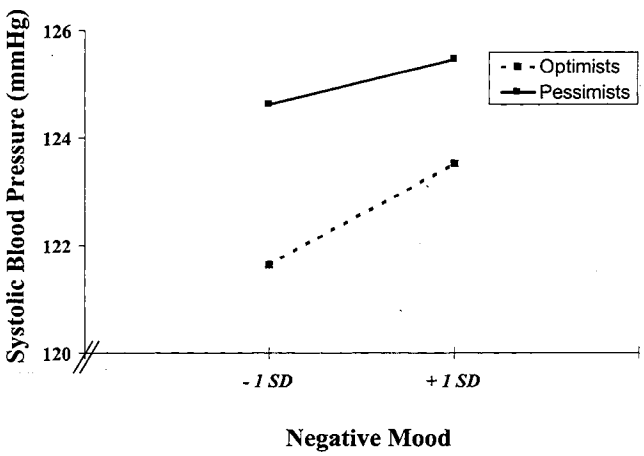

Figure 1. Association between pessimism and diary ratings of negative mood on ambulatory systolic blood pressure.

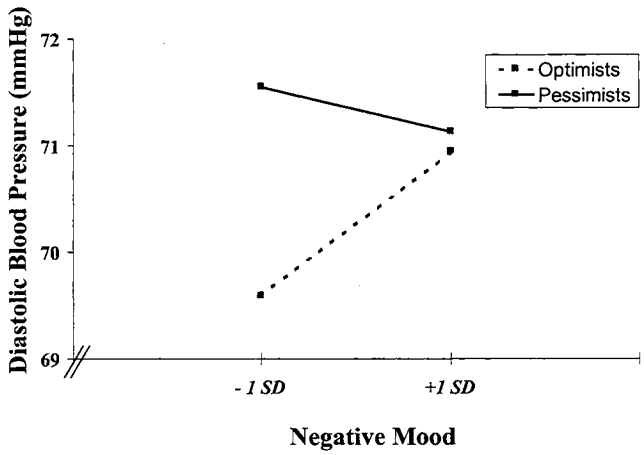

Figure 2. Association between pessimism and diary ratings of negative mood on ambulatory diastolic blood pressure.

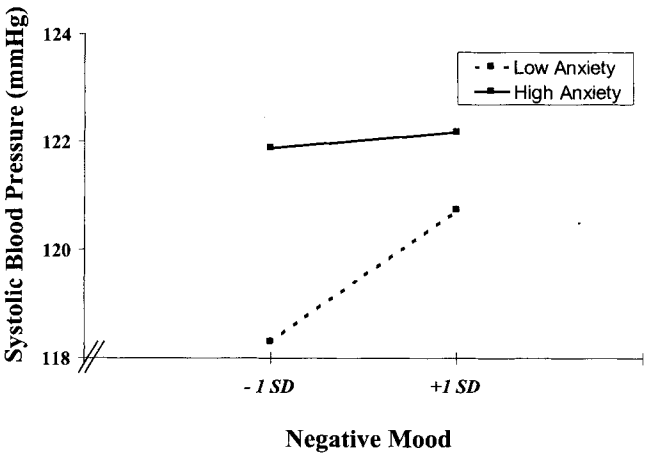

Figure 3. Association between anxiety and diary ratings of negative mood on ambulatory systolic blood pressure.

with low optimism scores ($ps < .052$). Table 4 shows that individuals scoring high on the Spielberger Trait Anxiety Inventory experienced more negative and less positive mood and felt more bored, tired, and apathetic than their low anxiety counterparts across the days of monitoring ($ps < .02$).

We also examined whether the effects of optimism–pessimism and anxiety on moods would be moderated by the occurrence of interpersonal interactions in general, the occurrence of negative interpersonal interactions, or home versus work location. The benefits of interpersonal interactions for positive mood were less pronounced for pessimists (according to overall LOT score), estimate = 0.48, $t(6980) = 4.08$, $p < .001$, and for anxious individuals, estimate = 0.48, $t(6980) = 3.98$, $p < .001$, than for their more optimistic, estimate = 0.83, $t(6980) = 7.51$, $p < .001$, and less anxious, estimate = 0.83, $t(6980) = 7.44$, $p < .001$, counterparts: overall LOT, $F(1, 6980) = 4.41$, $p < .04$, and anxiety, $F(1, 6980) = 4.48$, $p < .03$. There were no other significant interactions.

Unique effects of traits. Table 4 presents the results of the analyses of the independent influences of traits. After control for Spielberger Trait Anxiety Inventory scores, pessimists on the overall LOT as well as on the pessimism subscale felt more negatively and experienced more negative interpersonal interactions than their more optimistic counterparts, whereas those with high scores on the optimism subscale felt more positively than individuals with low scores. The effect of overall LOT score was nonsignificant in the analyses of positive mood, as were the effects of the optimism subscale in the analyses of negative mood and negative interpersonal interactions when statistical adjustment was made for trait anxiety. When overall LOT scores were controlled, higher trait anxiety scores were associated with more negative and bored moods.

Other relevant data. We analyzed whether dispositional optimism and trait anxiety would affect mood ratings measured at the end of each of the 3 days. Pessimists on the overall LOT rated their daily mood as more negative, $t = 2.68$, $p = .01$, and less positive, $t = -2.25$, $p = .03$, than optimists. With regard to the subscales, pessimists rated their daily mood as more negative than their counterparts, and optimists rated their daily mood as less negative and more positive. Dispositional optimism had no effects on boredom. Pessimists, determined by higher scores on either the overall scale or the pessimism subscale, perceived their most stressful or difficult events across the 3 days as more severe than their more optimistic counterparts, $ts(98) > 2.12$, $ps < .04$. Individuals high in trait anxiety rated their daily mood as more negative, $t(98) = 2.35$, $p < .02$; less positive, $t(98) = 3.25$, $p < .002$; and more bored, $t(98) = 1.80$, $p < .08$. Trait anxiety had no effects on perceived severity of the most stressful event across the 3 days. Dispositional optimism and trait anxiety were not related to BP levels measured in the initial laboratory assessment session ($ps > .20$).

Discussion

This study sought to determine whether dispositional measures of optimism, pessimism, and anxiety would affect ambulatory BP and mood monitored over a wide range of circumstances during routine everyday activities and whether any associations between these dispositions and BP would be moderated by mood. The findings indicated that pessimists routinely felt more negative, and, when in an interpersonal interaction, they experienced it as more negative, whereas optimists felt more positive. Pessimists, especially those with low optimism subscale scores, had higher overall SBP and DBP levels than their counterparts throughout the 3 days, even when they were not in a negative mood. However, when optimists and low pessimists did experience negative moods (albeit infrequently), they exhibited BP as high as that observed in pessimists and in low optimists. This may have been due to their well-documented efforts to use problem-focused strategies of coping with stress (for a review, see Scheier & Carver, 1985, 1987, 1992), which may cause BP and heart rate to be elevated during acute challenges (e.g., Sherwood, Dolan, & Light, 1990). Because of our analytic strategy, our results cannot be attributed to variation in posture, location, or physical activity of the optimists and pessimists at the time of the measurement or to gender or occupational prestige. Thus, the results confirm the study hypotheses and add to the existing literature by showing that pessimism confers adverse effects on psychological as well as physical well-

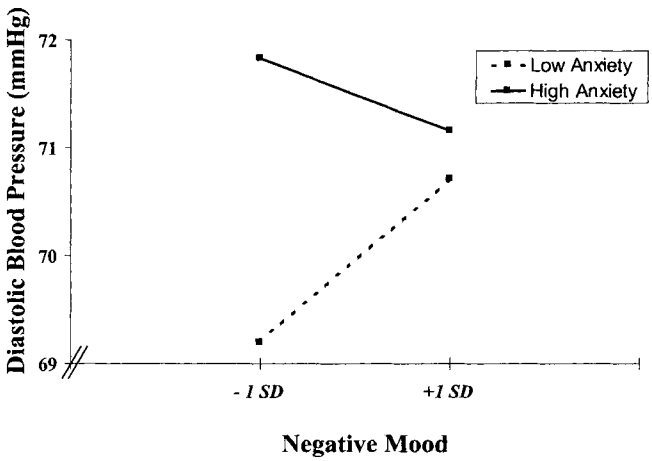

Figure 4. Association between anxiety and diary ratings of negative mood on ambulatory diastolic blood pressure.

Table 4
Average Ratings of Mood Across 3 Days in Optimists, Pessimists, and Anxious Participants

Measure	Negative mood			Positive mood			Bored mood			Negative interpersonal interactions		
	M	Adjusted[a] *p*	Unadjusted *p*	*M*	Adjusted[a] *p*	Unadjusted *p*	*M*	Adjusted[a] *p*	Unadjusted *p*	*M*	Adjusted[a] *p*	Unadjusted *p*
Dispositional Optimism												
Overall score		.001	.05		.03	.32		.18	.91		.002	.01
Low (optimism)	8.9			13.5			4.4			0.06		
High (pessimism)	9.4			12.5			4.3			0.10		
Pessimism subscale		.002	.04		.83	.52		.16	.62		.0001	.003
Low	9.0			14.3			3.7			0.05		
High	9.6			14.2			3.9			0.11		
Optimism subscale		.04	.42		.003	.03		.55	.53		.052	.17
Low	9.4			13.6			3.8			0.09		
High	9.0			15.0			3.8			0.06		
Trait anxiety		.001	.05		.02	.10		.005	.01		.58	.07
Low	8.9			14.8			3.7			0.06		
High	9.6			13.6			3.9			0.09		

[a] Adjusted for anxiety–optimism.

being, not only during highly stressful circumstances but across a variety of circumstances during routine everyday events.

The results from the analyses of trait anxiety are also potentially important. Similar to the results on optimism–pessimism, our data demonstrated that anxious individuals exhibited higher average levels of BP and reported feeling more negatively, less positively, and more bored during daily living than those with low anxiety levels. The BP levels of anxious individuals were elevated regardless of the presence or absence of negative mood, whereas low anxious individuals showed elevations in BP only when they were in a negative mood. Again, these associations were independent of fluctuations in posture, location, and physical activity, as well as independent of gender and occupational prestige. Although it has been argued that negative affectivity or neuroticism affects subjective health complaints and illness behavior but may not affect long-term health status (Watson & Pennebaker, 1989), our data do suggest that neuroticism, at least as measured by the Spielberger Trait Anxiety Inventory, is related to elevated BP throughout the day (even though it was not shown to be related to resting pressure measures in the laboratory). Perhaps the persistent elevations of BP and emotional responding of anxious individuals lead to future hypertension (Markovitz et al., 1991, 1993). If so, our data would suggest that neuroticism does, in fact, affect health directly.

From a psychophysiological perspective, giving up and turning away, characteristic of pessimists, and continued striving, characteristic of optimists (Scheier & Carver, 1985, 1987, 1992), are the defining features of defeat-type and defense-type reactions to stress, respectively (see Cannon, 1929; Henry & Stephens, 1977; Selye, 1946). Similarly, individuals high in trait anxiety attempt to alter the source of stress by passively avoiding or withdrawing from the situation rather than by attempting to actively cope with the situation (Smith et al., 1989). The defeat and defense reactions are two extremes of biological reactions to stress with different pathophysiological and metabolic profiles. It has been hypothesized that although the defense type of reaction to stress has effects, the physiological and metabolic influences of a defeat reaction are most consequential (for further discussion, see Björntorp, 1990). It has even been speculated that the more passive stance in defeat reaction may play a role in the development of primary hypertension (Henry & Grim, 1990). This perspective should be taken not to suggest that optimism–pessimism and anxiety be conceptualized by the two extremes of reaction patterns to stress but to offer further ideas about the physiological mechanisms by which these dispositions might confer adverse effects on health.

Regarding the discriminant validity of optimism and pessimism, our study findings demonstrated that optimism and pessimism contributed significantly and independently of trait anxiety to negative mood, perceived negative interactions, and diastolic BP alterations during everyday living. Anxiety contributed significantly and independently of optimism–pessimism to negative and bored moods and BP alterations during everyday living. Taken together, these findings suggest that dispositional optimism and anxiety have unique, albeit relatively similar, effects on psychological and physical well-being. The independent effects of optimism and anxiety obtained in the present study have been reported in previous literature (e.g., Bromberger & Matthews, 1996; Marshall & Lang, 1990; Robbins et al., 1991; Scheier et al., 1994).

The present study also evaluated whether the effects of dispositional optimism could be attributed to scores on the LOT pessimism or optimism subscales or their sum (total score). It appeared that the BP elevations of pessimists on the overall LOT were most apparent among those low on the optimism subscale. Negative mood states were elevated among both those high in pessimism and those low in optimism, but statistical adjustments for trait anxiety reduced the associations with optimism to nonsignificance. Positive mood states were elevated among those high in optimism but not those low in pessimism. These findings suggest that it would be fruitful to continue to examine associations with the total and subscale scores in future work so as to allow assessment of the similarity and dissimilarity of effects of high positive and low negative expectancies. Stated differently, the psychological and physiological consequences of endorsing low positive and high negative expectancies may be different.

There are a few notable limitations to our study. First, assessments

were made at regular time intervals (every 30 min) rather than randomly. Random time intervals between assessments would probably reduce any anticipatory effect of the upcoming assessment and would, therefore, be less likely to cause individuals to deviate from their usual activities (Stone & Shiffman, 1994). Wearing of the ambulatory monitor may have had some unique effects on the results (Blanchard, Cornish, Wittrock, & Jaccard, 1990), such as participants avoiding situations that would cause embarrassment because of the appearance of the monitor. However, unlike the study by Blanchard et al. (1990), our study used a silent ambulatory monitoring device, the measurement being less objectionable to individuals when they are wearing the monitor in the company of others and, therefore, less likely to cause them to depart from their normal behavioral patterns (Matthews et al., 1992). Despite this possibility, there is no reason to presume that any effects of anticipation or of wearing the monitor vary between optimists and pessimists or between those high and low in terms of anxiousness. Therefore, we find it unlikely that wearing the monitor and anticipating the measurement would bias the results in any systematic manner. Second, we examined normotensive middle-aged men and women without any chronic diseases and who did not use medications with cardiovascular and metabolic effects. The homogeneity of the health of the sample may, however, be more of a benefit than a limitation. At least, it is likely that the associations were not inflated because of the somewhat restricted variation in ambulatory BP levels.

Despite these possible limitations, there are a number of strengths of the study design and data-analytic strategy applied to address the research questions. An equal number of employed middle-aged men and women were recruited, and men and women were matched for their level of occupational prestige. A relatively large number of observations were made with relatively few missing values, strengthening the generalizability of the findings. The issue of generalizability extends to the present data-analytic strategy in which an individual was treated as a random variable (see Schwartz et al., 1994). That is, we did not assume that the within-subject effects of position, location, physical activity, or mood on BP and heart rate were identical for everyone or confounded by between-subjects effects. In such a case, investigators can legitimately make inferences about the larger population from which their samples are selected (Schwartz et al., 1994). The multilevel random regression analysis enabled the data to be evaluated at both the idiographic and the nomothetic level. At the idiographic level we examined intraindividual variability in mood and BP, and at the nomothetic level we examined interindividual differences in intraindividual variability between optimists and pessimists and between individuals high and low in terms of anxiousness. Thus, among the particular advantages of the multilevel random regression analysis approach used were the assumption of interperson variability in slopes and intercepts and the possibility of acknowledging the problem of correlated errors in a repeated measures design in which multiple observations are derived from the same participant over time.

In summary, using a sophisticated analytic technique, we found that optimists and pessimists had different experiences during the 3 days of monitoring, as did those who were high and low in terms of anxiousness. Presumably because of their general expectations about the likelihood of positive and negative outcomes, pessimists experienced high negative and low positive moods and had high ambulatory BP levels during their daily activities. Optimists experienced high positive and low negative moods and had low ambulatory BP levels except on the infrequent occasions when they were experiencing a negative mood. Anxious individuals experienced high negative moods, were bored, and had elevated BP levels. These experiences, should they occur repeatedly in their lives, would make optimists likely to live long, healthy lives and pessimists and those who are anxious likely to live short, unhealthy ones.

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