Does Unhappiness Make You Sick? The Role of Affect and Neuroticism in the Experience of Common Physical Symptoms

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The relative strength of both affective state and the personality trait neuroticism in predicting common physical symptoms was tested. The authors used an event-sampling design to overcome methodological limitations of past research in the area. Contrary to much previous research, neuroticism was found to be unrelated to reports of physical symptoms, although it was found to be related to unpleasant affective state. Unpleasant affect bore a strong concurrent relation to the frequency of reported symptoms. Temporal relations between experiences of unpleasant affect and subsequent symptoms were found for some individuals, but wide individual variability was seen in both the strength and direction of this linkage. The findings suggest that when individuals are asked to report their subjective experiences of physical illness without the necessity to retrospect over significant periods of time, unpleasant affective state is more strongly related to experiences of symptoms than is the trait neuroticism.

An important focus of research in health psychology has been the relation between personality and unpleasant affective states and major physical illness, including such ailments as asthma, ulcers, and heart disease (Friedman & Booth-Kewley, 1987; Suls & Rittenhouse, 1987). Recently, researchers have begun to explore this mind–body dynamic in the context of more common physical symptoms of minor illness that are regularly experienced in individuals' lives. Are unpleasant affect states predictive of minor physical illness? Some research suggests that it is. However, other research suggests that if a relation exists, it is inflated by the personality trait of neuroticism. The lack of consensus on this issue prompted the present study, which was designed to explore the relative influence of both of these factors on somatic health.

Affective State and Physical Symptoms

Research has been accumulating that indicates that various emotional stressors can adversely affect immune function and potentially impair resistance to illness (e.g., Bartrop, Luckhurst, Lazarus, Kiloh, & Penny, 1977; Glaser, Rice, Speicher, Stout, & Kiecolt-Glaser, 1986; Kiecolt-Glaser et al., 1986; Naliboff et al., 1991). Knapp et al. (1992), for example, using a laboratory emotion-induction procedure, found that the experience of unpleasant emotion promoted significant declines in mitogenic lymphocyte reactivity and increases in systolic blood pressure. A pleasant mood induction, however, did not lead to significant biological changes.

Other research has explored the role of emotional state in reports of minor physical illness itself. Emmons (1991) found that daily symptoms were significantly correlated with unpleasant affect but not pleasant affect. On days in which high levels of unpleasant affect were reported, more physical symptoms and less pleasant affect were reported. Larsen and Kasimatis (1991) used a daily sampling methodology and time-series regressions to show that moods predicted physical symptoms to a greater extent than previous symptoms predicted moods. Unexpectedly, it was pleasant moods, more than unpleasant moods, that generally predicted symptom occurrence. This counterintuitive finding was explained in terms of the context in which the reporting was done: A minor symptom, such as muscle soreness or headache, that occurs in the context of a pleasant mood is more likely to be noticed and complained about than the same symptom occurring in the context of an unpleasant mood. Qualifying this result were coefficients showing that the temporal relations between symptoms and moods were small, on average, and wide interindividual variation in the size of the mood–symptoms relation was observed.

Evidence for prediction of objectively confirmed physical illness from affective state comes from a prospective laboratory study by Cohen, Tyrell, and Smith (1993). Using nasal drops, researchers exposed individuals to a low, infectious dose of one of five common cold viruses. Participants who had experienced higher levels of unpleasant affect over the previous week were more likely to become infected with the introduced virus. This relation could not be explained by factors commonly associated with stress, including age, gender, education, weight, allergic...
status, health practices, and environmental characteristics associated with the study design. Thus, a growing body of research that is based on both self-report and objective verification indicates that affective state, particularly unpleasant affect, may have an influence on the development of physical illness symptoms.

Neuroticism and Physical Symptoms

Much attention has been given to the personality trait of neuroticism as a potentially important predictor of illness and illness reports. Neuroticism has been defined as "a broad dimension of individual differences in the tendency to experience unpleasant, distressing emotions and to possess associated behavioral and cognitive traits" (Costa & McCrae, 1987, p. 301). In a longitudinal study of men across a broad range, Costa and McCrae (1980) found that a wide variety of medical complaints were correlated with high levels of neuroticism. Individuals high in neuroticism reported two to three times as many symptoms as did men with the lowest scores on this trait (Costa & McCrae, 1985). Similar findings have been reported with a community-based sample of women (see Costa & McCrae, 1987).

A related line of work has been conducted by Watson (1988) and his colleagues (Clark & Watson, 1988; Watson & Pennebaker, 1989), who have explored the relation of Negative Affect (NA) and Positive Affect (PA) to health complaints. Trait NA appears to represent the broad emotional distress component of neuroticism (Costa & McCrae, 1987); further, trait NA has been proposed to be an alternative designation of neuroticism (Costa & McCrae, 1987; Watson & Clark, 1984). State NA is a transient mood factor corresponding to trait NA (Watson & Pennebaker, 1989).

NA has been shown to be correlated with reports of physical symptoms and psychophysiological disorders (Clark & Watson, 1988). A consistent link between trait and state NA and physical health complaints has been demonstrated in studies based on one-occasion measures and in those that use daily-report measures. For example, Watson and Pennebaker (1989) reported six studies in which measures of personality, stress, emotional functioning, and health were collected. Across studies, both one-occasion and daily-sampled trait and state NA were found to be related to self-report measures of physical symptoms. NA was not related to objective health status, a finding that has been frequently reported (Costa & McCrae, 1987), leading some investigators to suggest that neuroticism or NA represent a general trait of somatopsychic distress, expressed through a range of unpleasant affective states and somatic complaints (Costa & McCrae, 1985, 1987; Watson & Pennebaker, 1989).

In much of the research on negative affectivity and minor physical illness, researchers have used retrospective study designs, in which participants must rate moods and symptoms over the previous week, month, or more. Results described by Watson and Pennebaker (1989) showed that NA—symptom correlations were consistently higher when participants rated their symptoms over the previous few weeks than when they rated symptoms only for the current day. Thus, the NA—symptoms complaint relation and the lack of NA—objective illness relation may be at least partially due to retrospective methodologies, which introduce error in recording accuracy because of the inherent biases of long-term memory.

Retrospective memory biases have been found for personal life events, actions (Glass & Holyoak, 1986), and emotions (e.g., Teasdale & Fogarty, 1979). This issue may be an important consideration when research involves neuroticism and NA. Larsen (1992) found that the relation between neuroticism and concurrent symptoms was much smaller than the relation between neuroticism and recalled symptoms, suggesting that this trait is associated with a tendency to remember physical symptoms as being more prevalent than they really were.

There is some indication that even having individuals think back over a single day may introduce recall bias among highly neurotic individuals. Marco and Suls (1993) found that high-NA individuals did not report more daily stressors, including physical health problems, than did low-NA individuals. Unlike in other studies, however, stress events were sampled as they occurred during the day (eight times per day on a quasi-random schedule). In explaining the inconsistency between their own and other findings, Marco and Suls suggested that high- and low-NA individuals do not differ in the amount of problems experienced during the day, but by day’s end, high-NA individuals may be more likely to recall problems or low-NA individuals may be more likely to forget them. Either scenario could result in the association between NA or neuroticism and stressors, such as illness, found in studies using end-of-day or even more retrospective reports.

Is the link between neuroticism and self-reported illness a methodological artifact, due to designs using retrospective reports? Do such methodologies mask the relation between emotional state and both self-reported and objective symptoms that recent studies are finding? To examine these questions, a design is needed that both minimizes retrospectivity and controls for neuroticism while testing the emotion—symptoms relation.

To observe temporal relations between neuroticism, emotional state, and symptoms, we used a daily event-sampling methodology. The daily sampling approach has been advocated by a number of personality, social, and health researchers (e.g., Sommerfield & Curbow, 1992; Tennen, Suls, & Affleck, 1991; Wheeler & Reis, 1991) in the search for enduring and stable relations among psychological factors implicated in the course of illness. It has been suggested that the daily sampling methodology, although based on self-reports, effectively minimizes the memory biasing effect that the typical onetime, retrospective report measure allows (Moskowitz, 1994).

The present study had two purposes: (a) to overcome some of the methodological limitations of past research in testing the relations among neuroticism, affective state, and reported symptoms and (b) to test the relative strength of both neuroticism and affective state in predicting reported symptoms of illness. The link between neuroticism and health reports may be at least partly due to methodologies that use retrospective reports. When neuroticism is a powerful predictor of physical symptoms, the relation between emotions and symptoms may be masked. As such, we hypothesized that when retrospection was minimized using a daily event-sampling methodology, the relation between affective state and symptoms would be stronger than some past research has suggested. We also hypothesized that neuroticism would predict occurrences of unpleasant affect
but that unpleasant affective state would predict physical symptoms without significant inflation by neuroticism.

Method

Participants

Participants responded to advertisements placed in urban and suburban newspapers in the Montreal area. No condition was placed on their participation except that they be working at least 30 hr per week during regular daytime hours; we included this screening to fulfill a requirement set by other researchers working on the project (see Moskowitz, Suh, & Desaulniers, 1994). Of 100 individuals who began the study, 72 participants (33 men and 39 women), ranging in age from 19 to 63 years (M = 33 years), completed the study successfully without significant amounts of missing data (for which we eliminated 22 participants) or errors in data collection (for which we eliminated 6 participants). The sample was primarily White. At study intake, all individuals were free of chronic physical ailments and minor illnesses. Participants were paid $100 for taking part in the research.

Procedure

Participants completed a one-page form as soon as possible following every social interaction of 5-min duration or longer; every day for 20 days. The form requested information on the time of the interaction, emotions felt during the interaction, and the physical symptoms experienced during the interaction. Participants were given 10 forms to use per day, because previous research (Moskowitz, 1994) indicated that most people recorded an average of six interactions per day. Twenty forms were given to those who indicated that they would be likely to use more than 10 each day, but all were told to use as few or as many as their natural day-to-day behavior dictated. The data collection phase of the study took place between late January and early March. Using stamped, addressed envelopes that we had provided, participants returned completed forms to us each day following daily recording.

Signaling devices (beepers) were also given to participants; they were signaled on a quasi-random schedule three times per day on weekdays and twice per day on weekends, at which time they were to complete a form indicating the time that the signal occurred. We obtained these records to help ensure that affect and symptom reports were being completed throughout the day. Records of signal times were approximately 90% accurate.

Participants completed, on average, six forms per day across the 20 days of the study. For purposes of analysis, we grouped the event-sampled data into morning, afternoon, and evening periods according to the time of day in which reports were completed. When more than one report was completed within a single period, mean values for each variable were calculated. Thus, except for random missing data, each participant had 60 data points. Most participants completed at least one form, and often more, during each morning, afternoon, and evening period for the study's duration. Because the three variables were recorded throughout the day and evening, this study provided a window into the affective and illness-related experience that occurred over the course of the entire awake period of the participants' days.

Measures

Event-sampled affect measure. A checklist of nine emotion adjectives was used to assess affect; these adjectives were derived from Diener and his colleagues (Diener & Emmons, 1985; Diener, Larsen, Levine, & Emmons, 1985). In order of appearance, the nine affect adjectives listed on the form were worried/anxious, happy, frustrated, pleased, angry/hostile, enjoyment/fun, unhappy, joyful, and depressed/blue. This adjecti-
Scaled neuroticism measure. The NEO Five Factor Inventory (NEO–FFI; Costa & McCrae, 1992) was completed during the initial briefing session with study participants. The NEO–FFI is a well-validated 60-item measure of the five-factor model of personality. The neuroticism scale provides a measure of anxiety, hostility, depression, self-consciousness, impulsiveness, and vulnerability. In the present sample, the interitem coefficient alpha for the neuroticism scale was .89.

Retrospective symptom report. As stated in the introduction, many studies that have found a link between neuroticism and physical symptoms used designs that required individuals to think back in time, if only over small intervals such as a day, in reporting their experiences. If the impact of neuroticism on inflated symptom reports is a result of retrospection, a direct test of this hypothesis would compare retrospectively reported symptoms with event-sampled symptoms from the same individuals. A retrospective measure, completed at the close of the last (20th) day of the study, asked participants to check off symptoms they recognized having experienced that day. Responses to this measure were compared to the Day 20 event-sampled symptom data.

Plan of Data Analyses

The data were analyzed in two stages, both of which used multiple regression models. The first stage used aggregated data, in which the data collected across the 20 days of the study were collapsed into single scores on each variable for each participant. Each variable was first centered about zero on a within-subject basis, and the residual scores were used for analysis. Centering serves to minimize problems of multicollinearity between main effect and interaction effect predictors in linear models (Aiken & West, 1991; Marquardt, 1980).

The second stage of analysis to be reported was composed of within-subject hierarchical regressions, in which lagged effects on symptoms were examined. The time-ordered nature of the event-sampled data was preserved in these analyses, and therefore temporal relations between variables could be tested. Analysis at a within-subject level allowed for the examination of variability in the strength and direction of the temporal relations between variables.

Because our interest was in the relation among neuroticism, affect, and reported symptomatology as a whole, we sought to create an overall symptom score to use as a dependent variable measure. Using a structural model with the four observed symptom scores leading to a latent “illness” factor, we performed a principal-components analysis, which demonstrated that these four scores formed a meaningful cluster, $\chi^2(2, N = 72) = 0.70, p = .71$; Goodness of Fit Index (GFI; Jöreskog & Sörbom, 1988) = .995. The standardized regression weights on the symptom factors ranged from .65 to .86. Given that all four symptom categories were highly related to an illness construct, a mean symptom score was formed from the four observed scores after each had been standardized across participants.

Although participant age might be expected to influence the strength or nature of relations found in these analyses, particularly given the broad age range sampled, initial inspection suggested otherwise: The correlation between age and average frequency of total symptoms across days was nonsignificant, $r(71) = -.14, p > .05$. Similarly, there was a nonsignificant correlation between gender and total symptom frequency, $r(71) = .05, p > .05$. Therefore, all analyses were conducted on the sample as a whole.

Descriptive Statistics

Descriptive data for all personality, emotion, and symptom variables are presented in Table 1. The mean NEO–FFI neuroticism score (22.06) is similar to the norm (19.07) reported for adult populations by Costa and McCrae (1992). In general, participants experienced more than twice as many occurrences of pleasant as unpleasant affect. Among physical symptoms, low energy was experienced most frequently, followed in order by aches, respiratory difficulties, and eating/digestion problems.

All of the event-sampled variables were measured with a high degree of reliability across time. Across 60 time points, the coefficient alphas for both pleasant and unpleasant affect were .98. The coefficient alphas for the four symptom categories ranged from .97 to .99.

Multiple Regressions on Aggregated Data

We constructed a hierarchical regression model to examine the effects of neuroticism and affect on physical symptom frequency. The predictors included in the analysis were neuroticism score, mean pleasant affect frequency score across 20 days, mean unpleasant affect frequency score across 20 days, and two interaction terms: Neuroticism × Unpleasant Affect and Neuroticism × Pleasant Affect. The inclusion of both pleasant and unpleasant affect as predictors assumes that these two valence scores are independent over time. Independence has been demonstrated in past research (Diener & Emmons, 1985) and was confirmed in the present study; over 20 days, the correlation between reported frequency of pleasant and unpleasant affect was nonsignificant, $r(71) = .10, p > .05$. Table 2 shows the correlation matrix of the variables used in the regression model.

Because neuroticism has been shown in past research to be an important predictor of physical symptomatology, this variable was entered into the regression equation first, before the other

Table 1

<table>
<thead>
<tr>
<th>Variable</th>
<th>$M$</th>
<th>$SD$</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEO neuroticism</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Affect</td>
<td>22.06</td>
<td>9.19</td>
<td>4.00–43.00</td>
</tr>
<tr>
<td>Pleasant</td>
<td>0.73</td>
<td>0.20</td>
<td>0.21–1.00</td>
</tr>
<tr>
<td>Unpleasant</td>
<td>0.32</td>
<td>0.20</td>
<td>0.01–0.87</td>
</tr>
<tr>
<td>Physical symptoms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aches</td>
<td>0.26</td>
<td>0.26</td>
<td>0.00–0.99</td>
</tr>
<tr>
<td>Eating/digestion</td>
<td>0.14</td>
<td>0.19</td>
<td>0.00–0.84</td>
</tr>
<tr>
<td>Respiratory</td>
<td>0.22</td>
<td>0.30</td>
<td>0.00–1.00</td>
</tr>
<tr>
<td>Low energy</td>
<td>0.43</td>
<td>0.30</td>
<td>0.00–1.00</td>
</tr>
</tbody>
</table>

Note. Values for affect and symptoms represent the mean frequency of responses per form divided by the number of forms used over 20 days. Scores can maximally range from 0 to 1.
AFFECT, NEUROTICISM, AND SYMPTOMS

four predictors were given opportunity to explain variation in the dependent variable. The model was significant, \( F(5, 71) = 6.99, p < .0001, R^2 = .35 \). However, only one predictor, unpleasant affect, was significant \( t = 4.75, p < .0001 \).

Table 2 shows that neuroticism was significantly correlated with unpleasant affect. This suggests that unpleasant affect may play either a mediational or moderational role between neuroticism and symptoms. We tested both of these possibilities by using the procedures outlined by Baron and Kenny (1986). To test for mediation, we computed a series of three regression models: The first regressed unpleasant affect on neuroticism, the second regressed symptoms on neuroticism, and the third regressed symptoms on both neuroticism and unpleasant affect. The results of these models, shown in Figure 1a, indicate that whereas neuroticism significantly predicted unpleasant affective state, neuroticism did not predict symptoms, and only unpleasant affective state predicted symptomatology in the third model, which disconfirms a mediational role for affect.

To test for moderation of the neuroticism-symptoms relation by unpleasant affect, we used three terms as predictors of symptoms in a single regression model: neuroticism, unpleasant affect, and the interaction between these two terms. This model showed that although the main effect of unpleasant affect on symptoms was significant, the interaction was not, which indicates that unpleasant affect did not moderate the effect of neuroticism on symptoms (see Figure 1b). In sum, both tests indicate that unpleasant affective state alone influenced the occurrence of illness, with no contribution from the trait neuroticism.

Neuroticism—Retrospective and Neuroticism—Current Symptom Report Correlations

It has been suggested that neuroticism is associated with a tendency to overrecall symptoms, that is, to remember them as being worse than they really were (Larsen, 1992). To test this possibility, we compared correlations between neuroticism scores and event-sampled symptom reports done on the last day of the study with correlations between neuroticism scores and participants' reports of symptoms they remembered experiencing on the last day. Of the 72 participants, 30 completed this memory-based report at the end of the final day of the study. There was a significant correlation between retrospective reports of symptoms and event-sampled symptoms, \( r(29) = .73, p < .001 \). However, the size of the relation between neuroticism and each of these symptom measures was different. The correlation between neuroticism scores and retrospective symptom reports was .30. The correlation between neuroticism and event-sampled symptom reports was .05. The difference between these correlations was tested using a paired-sample \( t \) test. The difference between the two coefficients was significant, \( t(27) = 1.91, p < .05 \).

Table 2
Correlation Matrix of Aggregate Neuroticism, Affect, and Symptoms Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Neuroticism</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Unpleasant affect</td>
<td>.35**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Pleasant affect</td>
<td>-.19</td>
<td>.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Neuroticism x Unpleasant Affect</td>
<td>.09</td>
<td>.14</td>
<td>.14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Neuroticism x Pleasant Affect</td>
<td>.11</td>
<td>.16</td>
<td>.02</td>
<td>.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Symptoms</td>
<td>.21</td>
<td>.56****</td>
<td>.21</td>
<td>.06</td>
<td>.14</td>
<td></td>
</tr>
</tbody>
</table>

Note. \( df = 71 \). ** \( p < .01 \). **** \( p < .0001 \).

3 Because the effect of the independent variable (neuroticism) on the dependent variable was assumed to change linearly with respect to the moderator (affect), the interaction term was formed from a product of the continuous affect score and a dichotomized neuroticism score (using a median split). See Baron and Kenny (1986) for a discussion of the creation of such terms.

4 Although most participants ultimately completed this report, the reports that were not completed on the final day of the study were collected 1 day to 1 week following the event-sampling phase of the study. These reports were not included here because the range of retrospection required was so variable. Neuroticism scores for those participants included in these analyses who completed the memory-based symptom report at the end of the last day of event sampling did not differ from neuroticism scores for the remainder of the sample, \( t(63) = .78, p > .05 \).
Within-Subject Time-Lagged Regressions: Effects of Lagged Symptoms and Affective State on Symptoms Within Days

The results reported thus far indicate that among the variables measured in this study, only unpleasant affect co-occurs with physical symptoms. A primary purpose of this study was to examine whether affective state is predictive of symptoms. To demonstrate such an effect, it must be shown that unpleasant affect both temporally precedes and influences the occurrence of symptoms. In other words, unpleasant affect at Time t minus 1, for example, must be shown to influence symptoms at Time t. We assumed that the strongest predictive effect of unpleasant affect on symptoms would be at t minus 1, or one lag back from Time t symptoms (cf. Larsen & Kasimatis, 1991). Thus, only t minus 1 variables were used in the analyses. Hierarchical regression analyses were conducted using total symptom score at Time t as the dependent variable and three independent variables: t minus 1 total symptom score, Time t unpleasant affect score, and t minus 1 unpleasant affect score. The three independent variables were entered into the regression equation in the order listed. Entering lagged symptom score into the equation first, followed by Time t unpleasant affect score permitted us to account for variation that was theoretically expected to correlate with symptoms at any given time. Entering lagged unpleasant affect score only after this variation had been accounted for allowed us to test the predictive effect of prior unpleasant affect on symptoms independent of the effects of prior symptoms and concurrent unpleasant affect. The full regression model was

\[ \text{symptoms}_t = b_0 + b_1 \text{symptoms}_{t-1} + b_2 \text{unpleasant affect}_t + b_3 \text{unpleasant affect}_{t-1} + e. \]

Relations between Time t and t minus 1 variables were examined between consecutive time intervals (e.g., morning and afternoon, afternoon and evening). We were interested in within-day effects only, because we thought that affective experiences during an evening would be less likely to influence the occurrence of symptoms the following morning. Thus, we coded lags for the morning symptom data and unpleasant affect data as missing to eliminate across-day lags, which left 40 lag data points per participant for analysis.

To meet the assumption of independent residuals when using time-series data in linear modeling procedures such as multiple regression, one must check for and, if present, eliminate from the data three sources of nonindependence (West & Hepworth, 1991): the presence of linear or curvilinear trend in the data (positive or negative slope), cyclical components or seasonality, and serial dependence or autocorrelation. After centering and detrending each participant’s serial affect and symptom data, we checked for and detected weekly cyclicity in many of the participant’s symptom and, particularly, affect data. We removed these cyclical components and checked the residual scores (once they were in the regression model) for autocorrelation using the Durbin–Watson (D–W) statistic (Durbin & Watson, 1951).

This test is a measure of statistical independence of error terms in time-series data. Nonsignificant correlation (or independence) of error terms implies that the values in the time series are serially independent, a fundamental assumption of regression with time-series data. Typically, first-order autocorrelation, or correlation between adjacent error terms in a series, is of primary interest (Bowerman & O’Connell, 1993). Values of the D–W statistic can range from 0 to 4; a value of 2 indicates a complete lack of autocorrelation. In the present sample, D–W values ranged from 1.32 to 2.62, with a mean of 2.04.

Within Days

To calculate the hierarchical regression model for each participant so that we could observe differences between individuals in the relations explored by the model. To observe overall patterns in the relations found, we combined these within-subject results meta-analytically, using the method of adding \( t^6 \) (Judd & Kenny, 1981; Rosenthal, 1978). Table 3 displays the results of this meta-analysis, including statistics that detail the relation between each of the three independent variables and the symptom dependent variable. Across participants, both lagged symptom and concurrent unpleasant affect frequency showed strong relations to symptom occurrence, \( Z = 33.68, p < .001 \), and \( Z = 9.07, p < .001 \), respectively. Lagged unpleasant affect also showed a significant relation to symptom frequency, \( Z = 1.62, p = .05 \).

Table 3 also displays squared semipartial correlations, which show the proportion of variance in Time t symptoms accounted for by the three independent variables. Lagged symptoms explained a mean of 31% of the variance in Time t symptoms, Time t unpleasant affect explained a mean of 7%, and lagged unpleasant affect explained a mean of 3%. These average squared semipartial correlations translate into correlations of .56, .27, and .17, respectively.

Finally, Table 3 displays both mean and range values for the standardized regression coefficients (beta weights) and full-model correlation coefficients. Wide individual variation in the results is evident, with some participants showing negative and others, positive relations between the independent and dependent variables. Almost all (93%) of the sample showed a positive relation between lagged and Time t symptoms, and 75% showed a positive relation between Time t unpleasant affect and Time t symptoms. A positive relation between lagged unpleasant affect and Time t symptoms was found for 56% of the sample.

5 Larsen and Kasimatis (1991) showed that the effect of mood on symptoms across days was minimal. Research into the impact of stressful emotions on chronic disease conditions, such as arthritis (e.g., Affleck, Tennen, Urrows, & Higgins, 1994), has similarly shown nonsignificant affect–illness relations across days. Although the present research included one, and possibly two, illness factors (respiratory and, possibly, gastrointestinal problems) likely to be influenced by unpleasant affective states of longer duration than a day, their relative rarity in this sample suggested that within-day analyses would prove more revealing than a search for cross-day effects.

This form of meta-analysis is typically used for independent studies but is also amenable to independent samples within a single study, as in the present case. The present study used a “fully replicated” design, in which the parts (or subjects) are “conceptually equivalent but statistically independent” (Hunter & Schmidt, 1990, p. 451). As Hunter and Schmidt noted, values of the measures can then be treated as if they are from entirely different studies.
The variance in the standardized regression coefficients for the prediction of symptoms was greater than that expected on the basis of sampling error for lagged symptoms, $\chi^2(71, N = 72) = 287.76, p < .001$, and for concurrent unpleasant affect, $\chi^2(71, N = 72) = 116.79, p < .001$; for lagged unpleasant affect, $\chi^2(71, N = 72) = 77.57, p > .05$ (Hunter & Schmidt, 1990; cf. West & Hepworth, 1991). As such, a search for moderators of the relations between the symptoms dependent variable and the significant predictors was conducted.

Standardized regression coefficients (betas) for lagged symptoms and concurrent unpleasant affect, which represented relations between these independent variables and the dependent variable were correlated with a number of individual difference variables, including all five NEO-FFI scale scores, aggregated pleasant affect, aggregated unpleasant affect, aggregated symptoms across days, and several demographic variables (namely age, gender, and education level). One might expect that neuroticism would be related to a stronger affect–symptoms relation or a longer duration of symptoms, but this was not found ($ps > .05$). In fact, none of the NEO–FFI scale scores were important predictors (all $ps > .05$). Neither aggregated unpleasant affect nor aggregated symptoms correlated significantly with within-subject associations among symptoms and unpleasant affect ($ps > .05$). One variable did predict affect–symptoms relations. Individuals who experienced more pleasant affect overall (aggregated pleasant affect) were less likely to show a cotemporal relation between unpleasant affect and symptoms, $r(71) = -.22, p = .05$. Among the demographic variables, none bore a significant relation to the affect–symptoms or symptoms duration coefficients.

### Within-Subject Time-Lagged Regressions: Effects of Lagged Affective State and Symptoms on Affective State Within Days

Although not central to the purpose of this study, it would be of interest to know whether symptoms have a temporally predictive effect on the experience of unpleasant affect. This relation is often taken for granted as true for many individuals, but it has rarely been explored with time-series data. Investigation of the nature of the linkage, if any, may help to shed light on the temporal sequencing of experience from affect to symptomatology to affect. The hierarchical model structure used in the previous section was used here, with the affect and symptom terms reversed, so that affect at Time t was regressed on affect at t minus 1, then on symptoms at Time t, then on symptoms at t minus 1.

Interestingly, meta-analysis of the within-subject regressions showed that although both lagged affect and concurrent symptoms were positively related to unpleasant affect at Time t ($Z = 7.43, p < .001$, and $Z = 9.41, p < .001$, respectively), lagged symptoms bore a negative relation to Time t affect ($Z = -1.72, p < .05$). Thus, there is some indication that although heightened levels of unpleasant affect and symptoms co-occur and current unpleasant affect predisposes to later unpleasant affect, lower levels of unpleasant affective state temporally follow heightened levels of symptomatology.

### Discussion

This study had several major findings: (a) The frequency of unpleasant affective episodes was associated with the frequency of physical symptom reports; (b) a temporal relation between episodes of unpleasant affect and subsequent symptoms was found for more than half of the participants, even though there was wide individual variability in both the strength and the direction of this relation; and (c) the personality trait neuroticism was not associated with the frequency of physical symptom reports but was related to the frequency of unpleasant affective episodes.

### Neuroticism and Symptoms

Contrary to much previous research in this area, results of the present study indicate that neuroticism does not predict reports of physical symptoms. The absence of a relation between neuroticism and symptoms may have a methodological basis. If neuroticism is associated with a tendency to overrecall symptoms, that is, to remember them as being worse than they really are.

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7 When multiple analyses are done on time-series data, the studywise (or subjectwise) Type I error rate may be inflated. This test helps to determine whether “true” variation in the data is occurring over and above expected sampling error variation (West & Hepworth, 1991). In these calculations, the expected sampling error variance ($s^2$), used as the denominator of the chi-square statistic, is equal to $(1 - \beta^2)^2/T (T - 1)$, where $T$ is the mean number of time points across participants (cf. Affleck et al., 1994).
were (Larsen, 1992; Marco & Suls, 1993), the influence of neuroticism on the reporting of physical complaints may be weaker when the biases inherent in long-term memory have had less opportunity to operate, as in studies that sample events or experiences close to the time of their occurrence. Consistent with this idea, the present study found that when participants were asked to remember symptoms they had experienced over the course of one day, neuroticism was positively associated with the frequency of symptoms remembered but not with the frequency of symptoms recalled through event sampling.

The present findings also speak to the issue of the validity of self-report of health problems. Self-rated health correlates with physicians' ratings and is a significant predictor of mortality (Idler & Kasl, 1991; LaRue, Bank, Jarvik, & Hetland, 1979), and neuroticism and NA correlate with self-rated health, but these traits do not correlate with objective measures of health. Thus, self-rated health measures appear to have an organically suspect component representing the influence of neuroticism and trait NA. However, the present finding that neuroticism was not related to self-rated health when it was recorded without lengthy time delays suggests that self-report measures of health may be more valid when significant memory recall is not required.

This finding, however, does not negate the importance of trait NA and neuroticism as a confound or general nuisance factor (Watson & Pennebaker, 1989) in the collection of physical health self-reports but suggests that the influence of this trait on symptom reports will be lessened when individuals are asked to rate their health "at this time" or as close to the present as possible, rather than "in general," over some sizable period of time. In forming diagnoses, physicians and other health practitioners often must rely on their patients' retrospective reports of symptoms. Because overreporting of symptoms appears to be specific to long-term memory situations, health care providers may do well to seek reports of present-time symptoms from their patients when it is appropriate and possible to do so.

**Unpleasant Affective State and Symptoms**

Experiences of unpleasant emotion were related to reports of symptoms in both the aggregated data analysis, in which a concurrent relation was shown, and the within-subject analyses, in which a temporally predictive relation was found. These results are consistent with other studies, both laboratory and naturalistic, that have demonstrated that unpleasant affective state is a predictor of physical symptoms (e.g., Knapp et al., 1992).

It could be argued that the present findings simply suggest that state NA is a predictor of symptom reports. However, the measure of unpleasant affect used in this study was designed to be a "pure" hedonic measure of unpleasant affect without the arousal components of either state or trait NA (Larsen & Diener, 1992). Consistent with this argument, Watson (1988) found that "contrary to prediction, physical complaints are associated with a nonspecific unpleasant mood that includes lowered PA in addition to heightened NA" (p. 1024). Taken together with the previously reported findings, hedonic affective state appears to have a more direct link to physical health than do measures of affect or personality traits that incorporate both hedonic and arousal elements.

Interestingly, neuroticism did contribute to the prediction of emotional state, which is consistent with the negative affectivity model of Watson and Clark (1984) and with Costa and McCrae's (1980) model that hypothesizes that neuroticism leads to negative affect (termed dissatisfaction), which in turn leads to low subjective well-being. Our results suggest something similar, if self-perceived physical health can be said to reflect subjective well-being. However, because we used a purely hedonic measure of unpleasant affect, our data suggest that whereas neuroticism predisposes to unpleasant emotion, only unpleasant affective state itself predisposes to illness. However, it is still possible that neuroticism may serve as a vulnerability factor for symptom experiences, by increasing the rate of unpleasant affective states.

The finding that an average of only 3% of the variance in the frequency of symptoms was explained by prior unpleasant affect should not be taken to mean that this relation is not important (Rosenthal & Rubin, 1982). Evidence from studies of well-established risk factors such as cigarette smoking in coronary heart disease shows correlations of an average magnitude similar to that found between unpleasant affect state and subsequent symptoms in the present study. It may be that such established risk factors as cigarette smoking have become well known because the large-scale studies that have uncovered them have had sufficient statistical power to show a significant relation to illness (Friedman & Booth-Kewley, 1987).

The suggestion that unpleasant emotion leads to illness is tempered, however, by the wide variability in the temporal affect—symptoms relation that was found. With more than half of the participants showing a positive relation between unpleasant affect and subsequent symptoms, these results parallel those of Larsen and Kasimatis (1991) and those of DeLongis, Folkman, and Lazarus (1988), who examined the relation between daily hassles and both somatic health and mood. The search for moderators of variability in the present study indicated that individuals with generally higher levels of pleasant affect were less likely to show a co-occurrence of unpleasant affect and symptoms.

There are several other possible reasons for such variability, which this study was unable to explore: First, there may be important individual differences in symptom monitoring and in the psychological response to symptoms, which may influence symptom reporting (DeLongis et al., 1988). For example, some people, in particular those who evinced a negative relation between unpleasant affect and symptoms, may be more likely to notice health problems in the context of a pleasant mood than an unpleasant mood because they "stand out" from the background of feeling good emotionally (cf. Larsen & Kasimatis, 1991). Negative correlations between affect and symptoms could also appear if awareness of symptoms were to evoke a denial-like reaction in certain people. Conversely, others might use the fatigue, aches, or pains they experienced in response to unpleasant affect to make excuses or to gain attention from others; such people would likely show positive relations between unpleasant affective experience and somatic symptoms (DeLongis et al., 1988).

A second reason for variability, which is related to the first, is that there may be individual differences in response to unpleasant affective states. In particular, some individuals may use strategies to cope with undesirable episodes of affect or mood.
Problem-focused forms of coping, for example, have been shown to improve emotional state (e.g., Folkman, 1992). If coping is a successful means of reducing or eliminating unpleasant emotion, the somatic symptoms that arise from such affect may be less likely to appear, thereby reducing the likelihood of a relation between affect and subsequent symptomatology.

Third, a certain degree of severity of unpleasant affect may be required to bring about somatic problems. It is unlikely that mild unpleasant mood states, however diligently recorded in daily experience-sampling studies, will have much impact on physical well-being over a relatively short time period. Extreme episodes of unpleasant affect could be expected to have greater impact (cf. Cohen et al., 1993), but these are difficult to capture in the day-to-day lives of individuals, that is, with a degree of regularity sufficient to make data analyses feasible. Research with populations that could be expected to show high levels of affective variability may shed more light on this issue.

Fourth, some symptoms can be expected to have little or no emotional antecedents, because they are due to purely organic, environmental, or other causes. Temporally predictive statistical relations between affect and such symptoms will likely be close to zero. When somatic problems are minor, as in this study, consistent predictive relations may be unlikely, given the multiplicity of potential causes for such problems. For example, on any given day a backache may be due to emotional stress, to a poor sleeping position the night before, to a minor injury brought about by lifting a heavy object, or to a viral infection. The finding that in natural settings, a predictive relation does exist for some people is sufficient to suggest the importance of this mind–body relation. Future research in natural settings may do well to seek respondents’ explanations for their physical symptoms in order to pinpoint reasons, affect-related and otherwise, for experiences of ill-health.

The present study also found that although heightened levels of unpleasant affect temporally predisposed some individuals to heightened levels of reported symptoms, lower levels of unpleasant affect followed higher levels of symptoms. Although we can only speculate why this was so, it is possible that one’s mood may improve when previously experienced symptoms lessen over the course of a day. For example, the dissipation of a backache over time may be cause for relief or other pleasant emotions.8

An alternative or additional explanation is that the experience of somatic problems operates to turn attention inward or away from problems about which an individual feels angry, frustrated, or anxious, for example. Awareness of the need to conserve emotional or physical energy or to take care of one’s own health may lessen the perceived need to attend to matters about which one feels unhappy.

When placed in a temporal sequence, the results indicate a circular dynamic suggestive of a negative feedback loop that takes place between affective and somatic experience. Although increases in unpleasant affect can predispose to symptoms, the symptoms, in turn, may “serve” to decrease the affective experiences that accentuate physical problems, thus helping to bring both emotions and the body back into a healthier balance.

**Potential Limitations and Future Research**

The sampling procedure used in this study required individuals to record affective and symptom experiences that occurred during social interactions. Consequently, the data were collected in neither a random nor a completely systematic fashion with respect to time intervals. It is difficult to ascertain whether this requirement influenced the findings. However, the majority of participants’ data were collected throughout the morning, afternoon, and evening. As such, the data can be taken as generally representative of the experiences of affect and symptoms over the full course of individuals’ days. Moreover, it could be argued that anchoring reports to social interactions made reports more accurate. Monroe (1982) found that the more salient life events were to individuals, the more accurate was their recall of those events. If interactions with others can be considered salient events, tying reports to such events may have served to enhance accuracy on the affective and symptom experiences that occurred during that time frame.

This study also required that individuals be employed at least 30 hr per week during the daytime hours to fulfill a requirement set for other aspects of the research. Although this restriction helped to increase the homogeneity of the sample with respect to the time schedule of daily activities, the findings may not be generalizable to other populations, such as the unemployed, where financial, emotional, or other stresses may create different relations among the observed variables. Also, because our sample was largely White in composition, the results may not be generalizable to non-White ethnic groups.

Although research indicates that unpleasant emotion can influence the onset of objectively verified symptoms of illness (e.g., Cohen et al., 1993), studies, such as the present one, that rely on self-report alone cannot answer the question of whether it is actual symptom experience that is being tapped or biased perceptions of symptoms. Salovey and Birnbaum (1989) found that among individuals sick with a cold or flu, those who underwent an unpleasant (sad) mood induction reported more currently experienced symptoms of illness than similarly ill individuals who experienced a pleasant (happy) mood induction. Thus, unpleasant emotional states may promote exaggerated symptom reports. Such exaggeration assumes that one is in an unpleasant state when the symptom report is made. The analyses reported here, which show that lagged unpleasant affect was associated with symptom reports for some people even after the effect of concurrent affect was accounted for, suggest that this kind of exaggeration is not a complete explanation for reported experiences of symptoms. In the future, researchers would do well to assess the validity and reliability of nonretrospective self-report for tapping actual symptom occurrence, possibly through research designs that use both self-report and objective measures of symptoms, thus allowing for direct comparisons between these two sources of health information.

In conclusion, the present study confirmed previous research findings that unpleasant affective state bears a strong significant concurrent relation to the frequency of reported physical symptoms. A temporal relation between episodes of unpleasant affect and subsequent symptoms was also found, although there was wide individual variability in both the strength and direction of this relation. Neuroticism was not related to reports of symp-

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8 We are grateful to an anonymous reviewer for making this suggestion.
toms but was related to unpleasant affect state. These findings suggest that when individuals are asked to report their subjective experiences of physical illness without the necessity to think back over significant periods of time to do so, unpleasant affective state has a stronger influence on experiences of symptoms than does the personality trait of neuroticism. The findings have implications for the conduct of research in the health field when self-reports of physical symptoms are used, for the process of symptom-related information gathering by physicians and other health professionals, for the recognition of the importance of affect in illness prevention, and more broadly, for our understanding of the impact of emotions on physical health.

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