Does Unhappiness Make You Sick?

The Role of Affect and Neuroticism in the Experience of Common Physical Symptoms

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Abstract

The relative strength of both neuroticism and affect in predicting common physical symptoms was tested. An event-sampling design was used to overcome methodological limitations of past research in the area. Contrary to much previous research, neuroticism was not related to reports of physical symptoms, although it was related to unpleasant affect. 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 affect is more strongly related to experiences of symptoms than is neuroticism.

La force relative de la névrose et l'effet de celle-ci ont été analysés dans la prédiction des symptomes physiques. Un échantillonnage d'événements a été utilisé pour vaincre les limitations méthodologiques des recherches antérieures dans ce domaine. Contrairement à plusieurs recherches ultérieures, la névrose n'était pas lié à des rapports de symptomes physiques, malgré son lien à un effet désagréable. L'effet désagréable rapporte une importante relation simultanée à celle de la fréquence des symptomes rapportés. Des liens temporels entre des expériences d'effets désagréables et de symptomes subséquents ont été constatés chez certains individus, mais une grande variabilité individuelle a été observée autant dans la force que dans la direction de ce lien. Les résultats suggèrent que lorsque l'on demande à des individus de rapporter leurs expériences subjectives face à leurs maladies physiques sans jeter un coup d'oeil retrospectif sur une periode de temps significative, l'effet désagréable est plus fortement lié à des expériences de symptomes qu'à la névrose.

Does Unhappiness Make You Sick?

The Role of Affect and Neuroticism in the Experience of Common Physical Symptoms

An important focus of research in health psychology has been an examination of the relation between both personality and unpleasant affect, 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 mindbody dynamic in the context of more common and frequently occurring physical symptoms of minor illness that are regularly experienced in individuals' lives. Is unpleasant affect predictive of minor physical illness? Some research suggests that it is. However, other research suggests that if a relation exists, it is inflated by 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 upon somatic health.

Affect and Physical Symptoms

Several recent studies have explored the role of emotional state in minor physical illness. In a daily experience sampling study, Emmons (1991) found that daily symptoms were significantly correlated with unpleasant affect but not pleasant affect. On days where high levels of unpleasant affect were reported, more physical symptoms and less pleasant affect were reported. Eckenrode (1984) collected daily reports of mood, daily events, and symptoms from urban-dwelling women over a 1-month period. Physical symptoms were found to be a direct determinant of mood. However, the alternative model, mood influencing symptoms, was not tested.

While the direction of potential causality in these studies is not clear, other research has shed light on this question. Also using a daily sampling methodology, Larsen and Kasimatis (1991) used 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, which generally predicted symptom occurrence. This finding, contrary to intuition, was explained in terms of the context in which the reporting was done. A minor symptom such as muscle soreness or headache occurring in the context of a pleasant mood is more likely to be noticed and complained about (reported) than the same symptom occurring in the context of an unpleasant mood. Qualifying this result were coefficients showing that the lead/lag relations between symptoms and moods were, on average, small, and wide interindividual variation in the size of the mood-symptoms relationship was observed.

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

Evidence for prediction of objectively confirmed physical illness from affective state comes from a prospective laboratory study by Cohen, Tyrell, and Smith (1993). Individuals were exposed, using nasal drops, to a low infectious dose of one of five common cold viruses. Participants who had experienced higher levels of unpleasant affect over the past week were more likely to become infected with the introduced virus. These relations could not be explained by factors commonly

associated with stress, including age, gender, education, weight, allergic status, health practices, or environmental characteristics associated with the study design. Thus, a growing body of research based on both self-report and objective verification indicates that affect, and particularly, unpleasant affect has an influence upon the development of physical illness symptoms.

Neuroticism and Physical Symptoms

Much attention has been given to 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 with adult males across a broad age 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 and his colleagues (1988; 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 correlate with reports of physical symptoms and psychophysiological disorders (Clark & Watson, 1988). There is a consistent link between trait and state NA and physical health complaints in studies based on 1-occasion measures and in studies employing 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 1-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 which has been frequently reported (Costa & McCrae, 1987), leading some investigators to suggest that neuroticism, or NA, is 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, study designs have been retrospective in nature, in which subjects must rate moods and symptoms over the past week, month, or more. Results described by Watson and Pennebaker (1989) showed that NA-symptom correlations were consistently higher when self-reports of symptoms were rated over the past few weeks as compared to rating symptoms 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 due to 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 appears to be associated with a tendency to remember physical symptoms as being more prevalent than they really were.

There is some indication that even having subjects think back over a single day may introduce recall bias among highly neurotic individuals. Marco and Suls (1993) found that high NA subjects did not report more daily stressors, including physical health problems, than did low NAs. Unlike 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, these authors suggest that high and low NAs do not differ in the amount of problems experienced during the day, but by day's end, high NAs may be more likely to recall problems or low NAs may be more likely to forget them. Either 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 employing retrospective reports? Do such methodologies mask the relation between emotions and both self-reported and objective symptoms which recent studies are finding? To examine these questions, a design is needed which both minimizes retrospectivity and controls for neuroticism while testing the emotion-symptoms relation.

To observe temporal relations between neuroticism, emotion, and symptoms, a daily event sampling methodology was employed in the present study. The daily sampling approach has been advocated by a number of personality, social, and health researchers (eg., Somerfield & Curbow, 1992; Tennen, Suls, & Affleck, 1991; Wheeler & Reis, 1991) in the search for enduring and stable relationships among psychological factors implicated in the course of illness. It has been suggested

that the daily sampling methodology, while based on self-reports, effectively minimizes the memory biasing effect that the typical one-time, retrospective report measure can allow (Moskowitz, 1994).

The present study had two purposes: 1) to overcome some of the methodological limitations of past research in testing the relations among neuroticism, emotions, and symptoms, and 2) to test the relative strength of both neuroticism and affect in predicting symptoms of illness. The link between neuroticism and health reports may be at least partly due to methodologies employing retrospective reports. When neuroticism is a powerful predictor of physical symptoms, the relation between emotions and symptoms may be masked. As such, it was hypothesized that when retrospection was minimized using a daily event-sampling methodology, the relation between emotions and symptoms would be stronger than some past research would suggest. It was also hypothesized that neuroticism would predict occurences of unpleasant affect, but that unpleasant affect would predict physical symptoms without significant inflation by neuroticism.

Method

Subjects

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 hours per week in regular daytime hours; this screening was done 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 males, 39 females) ranging in age from 19 to 63 years (= 33 years) completed the study successfully without significant amounts of missing data

(22 subjects lost)[1] or errors in data collection (6 subjects lost). At study intake, all individuals were free of physical ailments. Participants were paid $100 for taking part in the research.

Procedure

Participants completed a 1-page form as soon as possible following every social interaction of five minutes duration or longer, every day for 20 days. The form requested information on the time of the interaction, a brief description of the interaction, with whom the interaction took place, behaviors engaged in by the participant, emotions felt during the interaction, and the physical symptoms experienced during the interaction. Subjects were given 10 forms to use per day, since previous research (Moskowitz, 1994) indicated that most people recorded an average of 6 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 provided to participants, completed forms were returned to the experimenters on each day following daily recording.

Participants completed, on average, 6 forms per day across the 20 days of the study. For purposes of analysis, the event-sampled data were grouped into morning, afternoon, and evening periods according to the times 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 occasional missing data, each subject had 60 data points. Most participants completed at least one, and often more forms during each morning, afternoon, and evening period for the study's duration. Because recording of the three variables was done throughout the day and evening, the design of the present study provided a window onto emotional and illness-related experience occurring over the course of the entire awake period of the participants' days.

Measures

Event-sampled affect measure. Nine emotion adjectives were used to assess affect; these adjectives were derived from Diener and his colleagues (Diener, Larsen, Levine, & Emmons, 1985; Diener & 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, depressed/blue. For each, a 7-point scale was displayed, anchored at 0 by "not at all" and at 6 by "extremely much". In the initial interview, participants were instructed to refer to knowledge of their own emotional range to guide their responses to this scale. Factor analysis in past research has shown that the 9-adjective set represents a single, bipolar factor, with the positive or pleasant adjectives loading on one pole and the negative or unpleasant adjectives loading on the opposite pole (Diener et al., 1985). Thus, this adjective set represents the pleasantness-unpleasantness dimension of emotion (Larsen & Kasimatis, 1991). As Green, Goldman, and Salovey (1993) demonstrated, the underlying structure of pleasant and unpleasant mood appears to be bipolar. The affect measure used is in contrast to the PA and NA measures employed by Watson and colleagues, which load onto two orthogonal dimensions of personality (Watson & Clark, 1984).

While unpleasant affect was hypothesized to be more strongly related to illness than pleasant affect, the decision to use a measure assessing both valences was made to avoid the potential bias inherent in using a scale heavily weighted with unpleasant emotion terms. As Marco and Suls (1993) suggest, such a scale may bias individuals' responses to affect items, or bias toward negative interpretations of events, including experiences of physical symptoms.

Two unpleasant affect frequency scores were derived: 1) for purposes of aggregate analyses, the mean number of responses to unpleasant adjectives were divided by the total number of forms used across 20 days; and 2) for purposes of within-subjects analyses, the mean number of responses

to the unpleasant affect adjectives in each time period were divided by the number of forms used in each time period. Pleasant affect frequency scores were calculated in a similar fashion.

Event-sampled physical symptom measure. The symptom measure consisted of four categories which were adapted from the factor analysis of symptoms conducted by Larsen and Kasimatis (1991). Under each category heading, examples were given: (1) aches (e.g., backache, headache, muscle soreness); (2) eating/digestion problems (e.g., nausea, upset stomach, constipation, diarrhea, poor appetite); (3) respiratory problems (e.g., shortness of breath, tightness in chest, congestion, sore throat, runny nose); (4) low energy (e.g., tired, bored, problems concentrating). For each category, a 7-point scale was shown, anchored at 0, "not at all" and at 6, "very severe". As with the affect measure, participants were instructed to refer to their own symptom history in judging intensity of current symptoms. Two symptom frequency scores for each category were derived: 1) for aggregate analyses, the number of responses for each category were summed and divided by the total number of forms used across 20 days; and 2) for within-subject analyses, the summed responses for each symptom category within each time period were divided by the number of forms used in each period. Symptom scores were created by first standardizing each category total score (used for aggregate data analysis) and then calculating means across symptom categories (used for within-subject analyses).

Scaled personality questionnaire. Several personality measures were administered before and after the daily report phase of the study. A number of these measures were of interest to other investigators on the research team. The neuroticism measure, from the NEO-FFI (Costa & McCrae, 1991), was of primary concern to this study and was completed during the initial briefing session with study participants. The NEO-FFI is a well-validated measure of the five factor model

of personality. The neuroticism scale provides a measure of anxiety, hostility, depression, self-consciousness, impulsiveness, and vulnerability.

Retrospective symptom report. As stated in the introduction, much past research which has found a link between neuroticism and physical symptoms has 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 upon inflated symptom reports happens through a retrospective process, a direct test of this hypothesis would be to compare retrospectively reported with daily 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 over the course of that day. Responses to this measure were compared to the Day 20 event-sampled symptom data.

Results

Plan of Data Analyses

Two primary kinds of analyses are reported. The first is a path analysis based on aggregated data, in which the data collected across the 20 days of the study have been collapsed into single scores on each variable for each subject. In the analysis, variables representing two-way interactions between each of the main effects were included in the initial computational run, but interaction variables were bivariately correlated ($R^2 > .85$) and/or multicollinear with main effect variables (tolerances < .05). Consequently, interactions were removed from the model subsequently reported.

The second major set of analyses to be reported are within-subject hierarchical regressions, in which tests of lagged effects upon 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.

While it could be expected that participant age may 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 ($r = -.12$, $p > .05$). 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 (22.87) is similar to the norm (19.07) reported for adult populations by Costa and McCrae (1991). In general, participants experienced more than twice as many occurrences of pleasant than unpleasant affect. Among physical symptoms, low energy was experienced most frequently, followed in order by aches, respiratory difficulties, and eating/digestion problems.

Insert Table 1 about here

Aggregated Data Path Analysis

A path analysis was conducted to examine the effects of neuroticism and affect on physical symptom frequency. Prior to the analysis, assumptions were evaluated and the dependent variable was log transformed to reduce skewness in the distribution, reduce the number of outliers, and improve the normality, linearity, and homoscedasticity of residuals.

The predictors included in the first analysis were neuroticism score, mean pleasant affect frequency score across 20 days, and mean unpleasant affect frequency score across 20 days. The inclusion of both pleasant and unpleasant affect as predictors assumes that these two affect valence

scores are independent over time. Independence has been demonstrated in past research (Diener & Emmons, 1985) and confirmed by the present study; over 20 days, the correlation between reported frequency of pleasant and unpleasant affect was .02[2].

An initial analysis showed that pleasant affect frequency was not an important predictor of symptoms, and an improvement in the fit of the model to the data was obtained by excluding this variable. The final model is shown in Figure 1. This model could not be rejected as a description of the data, chi-square (8) = 14.68, p = .07. The value of the Goodness of Fit Index (GFI; Jöreskog & Sörbom, 1988) was .94, indicating an excellent-fitting model. All four symptom categories were strongly reflective of the illness construct. Frequency of unpleasant affect was a significant predictor of illness, while neuroticism was not. However, neuroticism significantly predicted the occurrence of unpleasant affect. These results indicate that neuroticism does not affect illness, nor is its effect mediated by unpleasant affect, because neuroticism did not predict symptoms, and introduction of the full mediational path did not reduce the magnitude of the neuroticism-symptoms relation (Baron & Kenny, 1986). Thus, the occurrence of unpleasant affect alone influenced the occurrence of illness, with no contribution from neuroticism.

Insert Figure 1 about here

Neuroticism and Retrospective/Current Symptom Report Correlations

It has been suggested that neuroticism is associated with a tendency to "over-recall" symptoms, to remember them as being worse than they really were (Larsen, 1992). To test this possibility, correlations between neuroticism scores and event-sampled symptom reports done on the last day of the study were compared with correlations between neuroticism scores and participants'

reports of symptoms they *remembered* experiencing on the last day. Of the 72 participants, 31 completed this memory-based report at the end of the final day of the study[3].

The correlation between neuroticism scores and retrospective symptom reports was .22. The correlation between neuroticism and event-sampled symptom reports was - .03. A paired-sample t-test of the difference between the two correlation coefficients was significant, $t(28) = 1.87$, $p < .05$, one-tailed. While this difference is not large, neuroticism appears to have a greater effect on symptom reports when such reports are made retrospectively.

Within-Person Time-Lagged Regressions: Effects of Lagged Symptoms and Affect on Symptoms Within Day

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 affect 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-1, t-2, and so on, 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-1, or one lag back from time t symptoms (cf., Larsen & Kasimatis, 1991). Thus, only t-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-1 total symptom score, time t unpleasant affect score, and t-1 unpleasant affect score. The three independent variables were entered into the regression equation in the order listed. Entering lagged symptom score first into the equation and then time t unpleasant affect score permitted us to account for variation which 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-1 variables were examined between consecutive time intervals (e.g., morning and afternoon, afternoon and evening). Our interest was in within-day effects only, as it was considered less likely that affective experiences during an evening would influence the occurrence of symptoms on the following morning. Thus, lags for the morning symptom and unpleasant affect data were coded as missing data to eliminate across-day lags.

The hierarchical regression model was calculated for each participant so that differences between individuals in the relations explored by the model could be observed. A Durbin-Watson (D-W) test of autocorrelation was conducted on each participant's data. This test is a measure of statistical independence of error terms in time series data. When the error terms are nonsignificantly correlated, or independent, this implies that the values in the time series are independent, a fundamental assumption of regression using time series data. Typically, first-order autocorrelation, or correlation between adjacent error terms in a series, is of primary interest (see Bowerman & O'Connell, 1993 for discussion). Values of the D-W statistic can range from 0 to 4; a value of 2 indicates a complete lack of autocorrelation. Significance tests on the data using alpha = .05 showed that three subjects had data with significant autocorrelation; these subjects were dropped from further analyses. Remaining D-W values ranged from 1.20 to 2.76, with a mean of 1.99.

Table 2 shows the results of the within-subject regressions. This table reports the results of meta-analyses, using the method of adding zs (Judd & Kenny, 1981; Rosenthal, 1978), done on the relation between each of the three independent variables and the symptom dependent variable, combining the results of the 69 within-subject regressions.[4] Across subjects, both lagged symptom and concurrent unpleasant affect frequency showed strong relations to symptom occurrence, $Z = 38.81$, $p < .001$, and $Z = 10.83$, $p < .001$, respectively. Lagged unpleasant affect also showed a significant relation to symptom frequency, $Z = 1.93$, $p < .05$.

Insert Table 2 about here

Table 2 also displays the squared semi-partial correlations showing the proportion of variance in time t symptoms accounted for by the three independent variables. Lagged symptoms explained an average of 36% of the variance in time t symptoms, time t unpleasant affect explained an average of 7%, and lagged unpleasant affect explained a mean of 4% of the variance in time t symptoms. These average squared semi-partial correlations translate into correlations of .60, .27, and .20, respectively. Among participants who showed positive relations between the independent variables and symptoms, the sr^2 values were equal to or slightly higher than the average values.

Finally, Table 2 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 subjects showing negative, and others, positive relations between the independent and dependent variables. Almost all (98.5%) of the sample showed a positive relation between lagged and time t symptoms and 76.8% 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 52.2% of the sample.

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-square = 321.89, $p < .001$,[5] for concurrent unpleasant affect, chi-square = 139.43, $p < .001$, and for lagged unpleasant affect, chi-square = 104.84, $p < .001$ (Hunter & Schmidt, 1990; cf., West & Hepworth, 1991). As such, a search for moderators of the relations between the symptoms dependent variable and the three predictors was conducted.

Standardized regression coefficients representing relations between the three independent variables, and the dependent variable were correlated with a number of individual difference variables, including NEO-FFI neuroticism score, aggregated pleasant affect, aggregated unpleasant affect, aggregated symptoms across days, and several demographic variables, namely age, gender, and education level. It could be expected that neuroticism would be related to stronger affect-symptoms relations or longer durations of symptoms, but this was not found (p's > .05). Similarly, neither aggregated affect nor aggregated symptoms correlated with within-subject associations among symptoms and unpleasant affect (p's > .05). Among the demographic variables, none bore a significant relation to the affect-symptoms coefficients (p's > .05). However, age showed a significant relation to the symptoms-lagged symptoms coefficient ($r = .25$, $p < .05$), suggesting that as individuals get older, there is a tendency for symptoms to drag on longer over time.

Discussion

This study had several major findings: 1) the frequency of unpleasant affective state was associated with frequency of physical symptom reports; 2) a temporal relation between episodes of

unpleasant affect and subsequent symptoms was found for more than one-half of the participants, and there was wide individual variability in both the strength and direction of this relation; and 3) neuroticism was not associated with the frequency of physical symptom reports but was related to the frequency of unpleasant affect. Each of the major findings will be discussed in turn.

Neuroticism and Symptoms

Contrary to much previous research in this area, results of the present study indicated that neuroticism did 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 "over-recall" symptoms, to remember them as being worse than they really were (Larsen, 1992; Marco & Suls, 1993), the influence of neuroticism upon the reporting of physical complaints may be weaker when the biases inherent in long-term memory have less opportunity to operate, as they do in studies which sample events or experiences close to the time of their occurrence. Consistent with this idea, the present study found that when subjects were asked to remember symptoms they had experienced over the course of one day, neuroticism was positively associated with frequency of symptoms *remembered*, but neuroticism was not associated with the frequency of symptoms recorded through event-sampling. While the neuroticism-symptom memory correlation was relatively small, it would be expected to increase as the time lag between symptom episodes and recording of them were increased from one day to a week, a month or more (Larsen, 1992).

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 are significant predictors of mortality (Idler & Kasl, 1991; LaRue, Bank, Jarvik, & Hetland, 1979), and neuroticism and NA correlate with

self-rated health, but the 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/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 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 upon their patients' retrospective reports of symptoms. Since over-reporting of symptoms appears to be specific to long-term memory situations, health care providers may do well to seek reports of current or present-time symptoms from their patients when it is appropriate and possible to do so.

Unpleasant Affect 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 in the within-subject analyses, in which temporally predictive relations were found for about half of the participants. These results are consistent with the laboratory and naturalistic studies of others demonstrating that unpleasant affect is a predictor of physical symptoms (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 employed in this study was designed

to be a "pure" hedonic measure of unpleasant affect without relation to 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, unpleasant affect appears to have a more direct link to physical health than affect which is reflective of a personality trait such as state NA.

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 hypothesizing that neuroticism leads to negative affect (termed "dissatisfaction"), which in turn leads to low subjective well-being. Our results suggest something similar, if subjective well-being is taken in terms of self-perceived physical health. However, because we used a purely hedonic measure of unpleasant affect, our data suggest that while neuroticism predisposes to unpleasant emotion, only unpleasant affect itself predisposes to illness. Epstein and Katz (1992) also found that unpleasant affect played a central role in predicting symptoms, mediating the effects of stress and coping.

The fact that only an average of 4% of the variance in the frequency of symptoms was explained by prior unpleasant affect should not be taken to mean that the relations are not important (Rosenthal & Rubin, 1982). As Friedman and Booth-Kewley (1987) explain, squared correlations of this size translate into a relative risk of two - meaning that those with the risk factor (in this case, unpleasant affect) are twice as likely to experience illness as those without it. More compelling perhaps is evidence from studies of well-established risk factors such as cigarette smoking in coronary heart disease which show correlations of the same average magnitude as that found between unpleasant affect 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 which 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 fact that wide variability in the temporal emotion-symptoms relation was found, with slightly more than half of participants showing a positive relarion 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 uncovered a pattern for older individuals to have longer durations of symptoms, and no significant moderators of affect-symptoms relations.

There are several possible reasons for such variability which this study was unable to explore: Firstly, 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, and 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' more 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 affect and health symptoms (DeLongis et al., 1988).

A second reason for variability, related to the first, is that there may be individual differences in response to unpleasant affective states. In particular, some individuals may employ 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 successful in reducing or eliminating unpleasant emotion, the somatic symptoms arising from such affect may be less likely to appear, thereby reducing the liklihood of a relation between affect and subsequent symptomology.

Thirdly, a certain degree of severity or duration of unpleasant affect may be required to bring about somatic problems. It is unlikely that transient, mild unpleasant mood states, however diligently recorded in daily experience sampling studies, will have much impact on physical well-being. Extreme or longer-term 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 employing populations 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; these 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. All of the symptom categories studied here can be assumed to have a multiplicity of potential causes. Thus, consistendy strong predictive relations between

unpleasant affect and minor physical symptoms cannot and should not be expected. The fact that, in natural settings, a predictive relation does exist for some people is sufficient to suggest the importance of this mindbody relationship. Future research in natural settings may do well to seek respondents' explanations for their physical symptoms to pinpoint reasons, affect-related and otherwise, for experiences of ill-health.

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 had some influence on the findings. However, the majority of participants' data were collected throughout the morning, afternoon, and evening. As such, the data can be taken to be generally representative of the daily experiences of affect and symptoms over the full awake period of individuals' days. Moreover, it could be argued that anchoring reports to social interactions had a beneficial effect on the accuracy of reports. Monroe (1982) found that the more salient life events were to individuals, the better the recall accuracy of those events. If interactions with others can be considered salient events, it may be that tying reports to them served to enhance accuracy on the affective and symptom experiences occurring during that time frame.

This study also required that individuals be employed at least 30 hours per week during the day-time hours to fulfill a requirement set for other aspects of the research. While 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 operate to create different relations among the observed variables.

While 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 which rely upon self report alone cannot answer the question of whether actual symptom experience is being tapped or rather biased perceptions of symptoms. Salovey and Birnbaum (1989) found that among subjects currently sick with a cold or flu, those who underwent an unpleasant (sad) mood induction reported more currently-experienced symptoms of illness than similarly ill subjects 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 showing 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. Future research would do well to assess the validity and reliability of non-retrospective self-report to tap actual symptom occurrence, possibly through research designs which employ *both* self-report and, where they exist, objective measures of symptoms, thus allowing for direct comparisons between them.

In conclusion, the present study confirmed previous research finding that unpleasant affect bore 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 symptoms but was related to unpleasant affect. 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 affect has a stronger influence on experiences of symptoms than does 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 upon physical health.

Footnotes

[1] The most common reasons for missing data were absence of social interactions during particular time periods and loss of completed forms in the postal system. Participants' data were excluded from analyses if less than 67% of data were available across the 60 time points. Of the 4320 possible data points (72 participants x 60 time points), 3657, or 85% were available for analyses. Study completers and non-completers did not differ in age or neuroticism score (both ts ns), and data from an approximately equal number of males and females were excluded from analyses.

[2] The low correlation between pleasant and unpleasant affect should not be taken to mean that these two valences of affect are not bipolar. As Diener & Emmons (1985) show, the correlation between the two valences decreases in a linear fashion as the time span over which daily sampling is done increases. In several studies addressing the question of the independence versus bipolarity of mood, Green and associates (1993) found that when biases due to random and nonrandom response error were controlled, a bipolar structure of affect emerged. However, across studies, the correlation between the valences of affect dropped as the time span between assessments increased.

[3] Neuroticism scores for participants who completed this memory-based symptom report did not differ from neuroticism scores for the remainder of the sample (t=.10, ns).

[4] This form of meta-analysis is typically employed for independent studies but is also amenable to independent samples within a single study, as in the present case. The present study employs 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 (1990) note, values of the measures can then be treated as if they came from entirely different studies.

[5] In these calculations, the expected sampling error variance (s_e^2), used as the denominator of the chi-square statistic, is equal to $(1 - \bar{\beta}^2)^2 / (\overline{T} - 1)$, where $\overline{T}$ is the mean number of time points across subjects (c.f., Affleck, Tennen, Urrows, & Higgins, 1994; West & Hepworth, 1991).

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Table 1

Descriptive statistics for personality, emotion, and symptom variables

Variable	*Mean*	*SD*	*Range*
NEO neuroticism	22.87	9.15	4.00 to 43.00
Affect			
Pleasant	0.73	0.19	0.24 to 1.00
Unpleasant	0.33	0.20	0.01 to 0.87
Physical Symptoms			
Aches	0.27	0.27	0.00 to 0.99
Eating/Digestion	0.15	0.19	0.00 to 0.84
Respiratory	0.21	0.28	0.00 to 1.00
Low Energy	0.45	0.29	0.00 to 1.00

Note. Values for affect and symptoms represent the mean frequency of responses per form divided by the number of forms used over 20 days.

Table 2

Within-Subject Time Series Regressions on the Frequency of Symptoms: Meta-Analytic Results and Mean and Range Values for Standardized Beta Weights, Sr^2, and Full Model R^2

Independent Variables	*Z*	*Mean Beta*	*Beta Range*	*Mean Sr^2*	*Sr^2 Range*
$Symptoms_{t-1}$	38.74**	0.51	-0.24 to 1.00	0.36	0.00 to 0.99
$Unpleasant\ Affect_t$	10.82**	0.18	-1.06 to 0.90	0.07	0.00 to 0.80
$Unpleasant\ Affect_{t-1}$	1.92*	0.05	-0.36 to 1.24	0.04	0.00 to 0.42

R^2 model:

mean = .46

range = .04 to .99

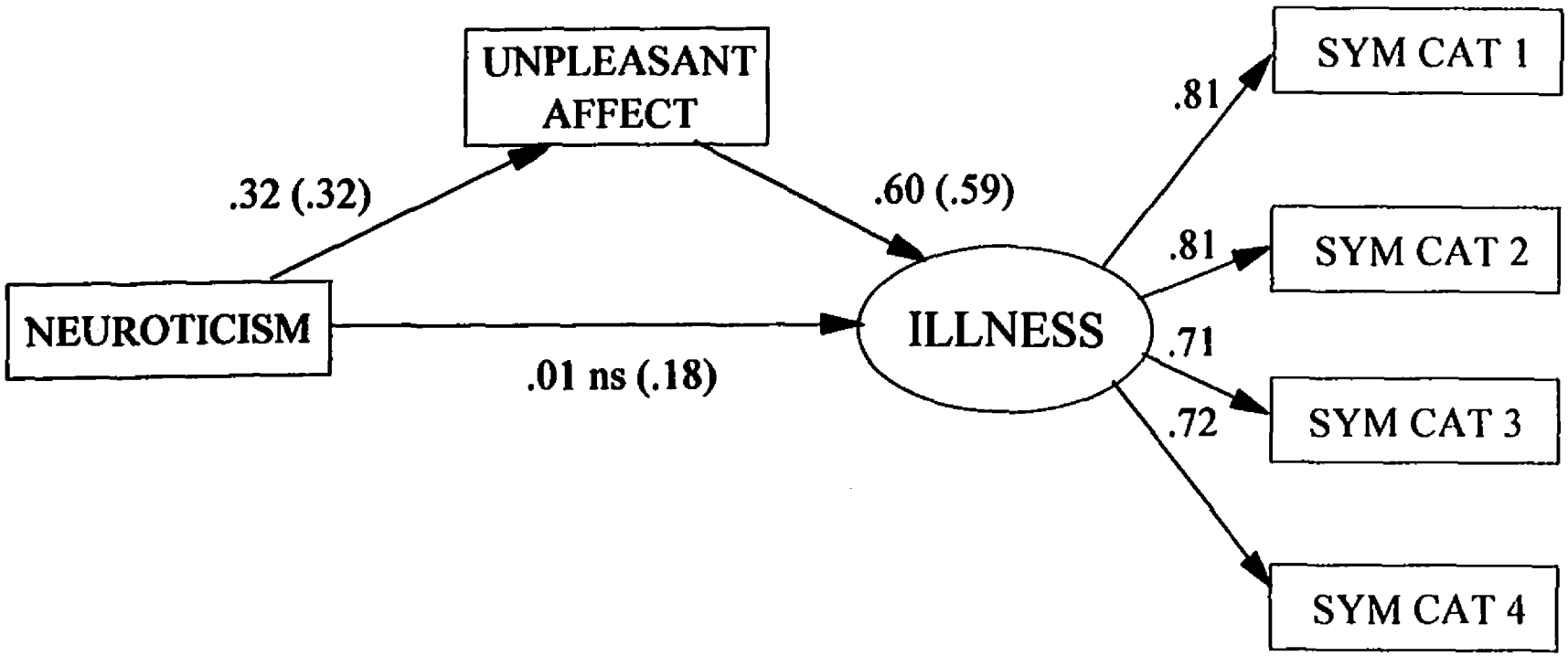
** $p < .001$ * $p < .05$

Note. Based on 69 within-subject regression analyses. The mean model R^2 value and the Sr^2 values do not exactly coincide due to rounding.

Figure 1

Path diagram for model testing direct and indirect effects of neuroticism on physical symptom frequency.

Notes. Affect and symptoms are aggregated data variables. Values outside parentheses are standardized regression coefficients. Values inside parentheses are simple correlations. All relations are significant unless otherwise indicated. SYM CAT 1 to SYM CAT 4 = symptom categories 1 to 4.


UNPLEASANT AFFECT
.32 (.32)
.60 (.59)
NEUROTICISM
.01 ns (.18)
ILLNESS
.81
.81
.71
.72
SYM CAT 1
SYM CAT 2
SYM CAT 3
SYM CAT 4