

## The Impact of Personality on the Reporting of Unfounded Symptoms and Illness

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This study examined the role of personality in the reporting of symptoms and illness not supported by underlying pathology. After assessment of the Big Five personality factors, 276 healthy volunteers were inoculated with a common cold virus. On each of the following 5 days, objective indicators of pathology, self-reported symptoms, and self-reported illness onset were assessed. Neuroticism was directly associated with reports of unfounded (without a physiological basis) symptoms in individuals at baseline and postinoculation in those with and without colds. Neuroticism was also indirectly associated with reports of unfounded illness through reports of more symptoms. Openness to Experience was associated with reporting unfounded symptoms in those with verifiable colds, whereas Conscientiousness was associated with reporting unfounded illness in those who were not ill.

It is a widely held belief that personality can influence the perception and reporting of physical symptoms (Costa & McCrae, 1985; Pennebaker, 1982; Watson & Pennebaker, 1989). As symptom perception presumably contributes to defining oneself as ill, personality characteristics linked to symptom reporting may also have implications for the reporting of illness (Wiebe & Smith, 1997). The identification of factors that influence illness reporting is important given the large number of individuals who seek medical care for somatic complaints that are not attributable to organic causes (Lipowski, 1988). As of yet, there is limited evidence on the role of personality in the reporting of illness. Although illness reports are expected to follow from the perception of physical symptoms, illness reporting may depend on additional psychological processes as well (Cohen & Williamson, 1991). We

examine whether different personality traits are linked to symptom and illness reporting to provide insight into the processes underlying these stages of illness representation.

Much of the evidence for personality biases in symptom reporting comes from studies of neuroticism (Costa & McCrae, 1985; Watson & Pennebaker, 1989). These studies have generally shown that although neuroticism is related to reporting more frequent and severe symptoms, it is not related to the onset of objective disease.<sup>1</sup> For example, neuroticism is prospectively related to reports of angina pectoris (chest pain) but not to objective signs of coronary artery disease (Costa, 1987; Shekelle, Vernon, & Ostfeld, 1991). A prospective study in which healthy participants were intentionally exposed to common cold viruses similarly indicated that neuroticism is associated with increased reports of common cold-related symptoms after objective signs of disease are controlled for (Cohen et al., 1995). This later study is unique in this literature because it provided direct evidence that the relation between neuroticism and reporting more symptoms is independent of actual disease course.

Several broad mechanisms have been proposed that may explain the relation between neuroticism and symptom reporting and that are expected to operate in both healthy individuals and those who are sick. One type of explanation suggests that attentional processes contribute to the relation between neuroticism and symptom reporting. For example, Gray (1982) argued that there is an area of

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<sup>1</sup> Given the correlational nature of this research, the direction of the bias is unclear. Individuals high in neuroticism may overreport symptoms or those low in neuroticism may underreport symptoms relative to the number of symptoms justified by some objective standard for illness. Theoretical explanations tend to focus on the processes that may lead individuals high in neuroticism to overreport symptoms (Watson & Pennebaker, 1989).

the limbic system, the behavioral inhibition system (BIS), that is responsible for comparing actual with expected stimuli and coordinating behavior when there is a mismatch between them. Individuals high in neuroticism are thought to have an overactive BIS, which treats all stimuli as important. In turn, this attentional focus is thought to lower the threshold for defining bodily sensations as symptoms (Cioffi, 1991). Individuals high in neuroticism also tend to be more self-conscious and introspective in nature, and this self-focus may lead to a lower threshold for perceiving physical symptoms (Watson & Clark, 1984). Another type of explanation suggests that biases in the interpretation and recall of physical sensations contribute to the relation between neuroticism and symptom reporting. Neuroticism has been associated with a general tendency to interpret benign and distress-related sensations in a negative manner (Barsky & Klerman, 1983; Watson & Clark, 1984). Individuals high in neuroticism also tend to recall their symptoms as being worse than they were perceived at the time of encoding. This results in reporting greater numbers of symptoms and more severe symptoms on retrospective measures (Brown & Moskowitz, 1997; Larsen, 1992).

Most studies have looked at the association between neuroticism and the reporting of nonspecific symptoms in healthy participants (e.g., Robbins, Spence, & Clark, 1991; Watson & Pennebaker, 1989). Although proposed mechanisms linking neuroticism and symptom reporting are expected to operate in both healthy and sick people, only a few studies have addressed the role of neuroticism among those with a verified disease. For example, studies with diabetic patients show that neuroticism is associated with a propensity to report more medically unexplained symptoms, symptoms related to hypoglycemia (low blood glucose), worry about hypoglycemia, and severe physical and emotional problems related to diabetes (Deary, Clyde, & Frier, 1997; Deary & Frier, 1995; Hepburn, Deary, MacLeod, & Frier, 1994). The researchers conducting these studies did not, however, control for objective illness. In a previous study, we used the viral inoculation paradigm to examine whether neuroticism was associated with reporting more cold symptoms in healthy individuals at baseline and in the same individuals after they developed colds (Cohen et al., 1995). Although neuroticism was not associated with reporting symptoms when participants were healthy, it was associated with sick participants reporting a greater number of symptoms. The failure to find an association at baseline was attributed to the use of a cold-specific instead of a general symptom inventory. However, the finding that individuals with colds reported more unfounded symptoms established an important association between neuroticism and the exaggeration of true symptoms of underlying illness.

Personality characteristics other than neuroticism may also influence the perception and reporting of symptoms (Kirmayer, Robbins, & Paris, 1994). Introversion (low extraversion) is associated with greater physiological responsiveness to sensory stimuli such as pain (Stelmack, 1990). In spite of having higher thresholds for pain, extraverted individuals, as shown by evidence from samples of chronic pain sufferers, are more likely to report pain symptoms than introverted individuals (Harkins, Price, & Braith, 1989; Philips & Jahanshahi, 1985; Wade, Dougherty, Hart, Rafii, & Price, 1992). Kirmayer and colleagues (1994) also suggested that openness, which reflects absorption in one's experiences, may be associated with the tendency to attend to somatic sensations that, in turn, may lead to reports of more symptoms.

What about the effects of personality characteristics on biases in the reporting of illness? Because illness reports are expected to follow from the perception of physical symptoms, neuroticism may be indirectly associated with illness reporting through symptom reporting. Similarly, if other personality characteristics, such as extraversion and openness, influence symptom reporting, they could be similarly related to illness reporting through symptoms. It is also possible that neuroticism and other personality characteristics have direct effects on illness reporting. For example, the hypothesis that neuroticism results in a tendency to interpret somatic experiences in a negative manner suggests a direct relation as well (Kirmayer et al., 1994; Pennebaker & Watson, 1991). Personality may also influence other psychological processes thought to be involved in illness reporting (Cohen & Williamson, 1991). These processes include clustering symptoms into symptom sets based on memories of prior illness and disease prototypes (Bishop, 1991), attending to aspects of the symptom course (e.g., the appearance of novel symptoms; Pennebaker, 1982), and assigning labels to symptom sets (Leventhal & Diefenbach, 1991). In addition, individuals may seek informational support or engage in social comparison processes at this stage of illness representation so they may evaluate their symptoms and label symptom sets (Croyle & Jemmott, 1991; Sanders, 1982). Given that these processes differ from those involved in symptom reporting, the personality characteristics that predict biases in illness reporting may differ. For example, there has been speculation that conscientiousness, which includes the qualities of being cautious and thorough, may be linked to greater illness worry and hypervigilance for signs of illness (Kirmayer et al., 1994). Individuals high in openness may also experience greater illness worry through susceptibility to suggestions that they may be ill originating from their own symptom experiences or the illnesses of others (Kirmayer et al., 1994).

The viral inoculation paradigm was used in the current study to investigate personality factors related to separate stages of illness representation, including the reporting of baseline symptoms, postinoculation symptoms, and postinoculation illness. We expanded on earlier work (Cohen et al., 1995) by investigating the roles of the Big Five Factors of normal personality (Costa & McCrae, 1987) in symptom and illness reporting. With the large sample in the study, we were also able to investigate the extent to which these biases occurred among those who developed verifiable colds in response to the virus and those who did not. After having their personalities assessed, participants were exposed to a virus that causes the common cold and then were quarantined for 5 days. Subjective and objective markers of disease were monitored over the course of the study. On the basis of prior studies, it was hypothesized that Neuroticism would be associated with reporting more symptoms at baseline, as well as the reporting of unfounded (without a physiological basis) postinoculation symptoms, among both those who developed colds and those who did not. Although lacking empirical support, there is also reason to expect that Extraversion and Openness to Experience will be related to greater symptom reporting and that Openness to Experience and Conscientiousness will be related to the reporting of unfounded illness.

## Method

### Participants

The participants were 125 men and 151 women judged to be in good health. They ranged in age from 18 to 55 years old ( $M = 29$ ,  $SD = 9.1$ ). The sample was 81% White, 15% African American, 2% Asian, and 1% Hispanic or Latino.

### Experimental Plan

Detailed methods are reported in Cohen, Doyle, Skoner, Rabin, and Gwaltney (1997). After the assessment of demographic characteristics and the Big Five Factors of personality, and after having their blood drawn to be examined for antibodies to the inoculation virus, participants were exposed to a rhinovirus (RV) and monitored for 5 days (in quarantine) for the development of infection and for signs and symptoms of a common cold. They were given nasal drops containing a low infectious dose (100–300 tissue-culture infectious dose<sub>50</sub>/ml) of one of two types of rhinovirus (147 participants were given RV39, and 129 participants were given Hanks). Although housed individually, they were allowed to interact with each other at a distance of 3 ft (0.9 m) or more. Nasal secretion samples for virus cultures were collected on the day before viral inoculation and each of the 5 days following collection. On each day, participants reported respiratory symptoms, noted whether they had a cold, and were tested for two objective indicators of pathology: nasal mucociliary clearance and nasal mucus production. Approximately 28 days after inoculation, another serum blood sample was collected for serological testing.

### Big Five Personality Characteristics

To assess the Big Five Factors of personality, we used a modified version of Goldberg's (1992) adjective scales. Our version included 50 adjectives, 10 for each factor. Personality traits were measured 1 and 3 weeks prior to viral inoculation, and responses were averaged across the two administrations of the scale. The internal reliabilities of the scales across the administrations were as follows: Extraversion,  $\alpha = .84$  to  $.87$ ; Agreeableness,  $\alpha = .80$  to  $.84$ ; Conscientiousness,  $\alpha = .83$  to  $.85$ ; Neuroticism,  $\alpha = .78$  to  $.81$ ; and Openness to Experience,  $\alpha = .78$  to  $.80$ . The test-retest correlations for each scale were as follows: Extraversion,  $r = .86$ ; Agreeableness,  $r = .84$ ; Conscientiousness,  $r = .87$ ; Neuroticism,  $r = .79$ ; and Openness to Experience,  $r = .81$ . Descriptive statistics for the personality characteristics are provided in Table 1.

### Standard Control Variables

Data were collected on a set of nine control variables, which might provide alternative explanations for the relations between personality factors and biases in the reporting of symptoms and illness. Age and body mass (weight in kilograms divided by the square height in meters) were scored as continuous variables. Whether the trial was conducted in the fall

**Table 1**  
*Descriptive Statistics for Personality Factors*

Factor	<i>M</i>	<i>SD</i>	Sample range (scale's range = 0–40.00)
Agreeableness	32.02	4.74	15.00–40.00
Conscientiousness	28.54	5.63	6.50–40.00
Neuroticism	11.70	5.29	1.00–27.50
Extraversion	27.85	6.53	5.83–40.00
Openness to Experience	27.95	5.46	12.50–40.00

(November) or spring (April), race (81% White, 19% non-White), sex (45% male, 55% female), marital status (27% married, 73% unmarried), viral type (53% RV39, 47% Hanks), and possession before the study of antibodies to the virus to which they were exposed (48% had prechallenge antibody titer  $\geq 4$ , 52% had prechallenge antibody titer  $< 4$ ) were scored as dichotomous variables. Education levels were categorized as high school graduate or less (20%), some college (58%), and bachelor's degree or greater (22%).

### Self-Report Measures of Symptoms and Illness

**Symptom reports.** On the day before (baseline) and for 5 days after exposure, participants rated the presence and severity of eight respiratory symptoms (congestion, runny nose, sneezing, coughing, sore throat, malaise, headache, and chills) during the previous 24 hr (Farr et al., 1990). Symptom checklists were completed in the early evenings. Ratings were provided on a scale from 0 (*none*) to 4 (*very severe*) for each symptom. A dichotomous baseline symptom score was created (0 vs. 1 or more symptoms), because the mode and median baseline number-of-symptoms scores were 0. We created two different symptom measures from daily reports regarding these eight symptoms: the number of symptoms reported and the severity of reported symptoms (Cohen et al., 1995). To create the first measure, we summed the number of symptoms reported each day after the viral inoculation. Then, the number of symptoms reported the day before the viral inoculation was subtracted from each daily symptom-number score. The total number-of-symptoms score was the sum of the adjusted number of symptoms for the 5 postinoculation days. To create the second measure, we summed symptom severity scores within each postinoculation day. The symptom severity score for the day before inoculation was subtracted from each daily symptom severity score after the viral inoculation. The total postinoculation measure was the sum of the adjusted severity of symptoms scores reported across the 5 postinoculation days.

**Illness reports.** Each day participants were asked if they had a cold. Self-reports were based on their own definition of illness.

### Objective Measures of Symptoms and Illness: Infection and Signs of Disease

Infectious diseases result from the growth and action of microorganisms or parasites in the body (see Cohen & Williamson, 1991). Infection is the multiplication of an invading microorganism. Clinical disease occurs when infection is followed by the development of symptomatology characteristic of the disease.

We used two common procedures for detecting infection by a specific virus. In the viral isolation procedure, nasal secretions were inoculated into cell cultures. If the virus is present in nasal secretions, it grows in the cell cultures and can be detected. Alternatively, one can indirectly assess the presence of a replicating virus by looking at changes in serum antibody levels to that virus. An invading microorganism (i.e., an infection) triggers immune system production of antibodies. Because RV-neutralizing antibodies recognize only a single type of RV, the production of antibodies for a specific virus is evidence for the presence and activity of that agent.

Nasal washes were performed daily during quarantine to provide samples of nasal secretions for virus cultures (Gwaltney, Colonna, Hamparian, & Turner, 1989). We tested for neutralizing antibodies to the challenge virus in pre- and 28-day postchallenge serum samples (Gwaltney et al., 1989). Serum antibody titers are reported as reciprocals of the final dilution of serum.

On each day of quarantine, we measured two objective signs of disease: mucus production and mucociliary clearance function. Mucus production was assessed by collecting used tissues in sealed plastic bags (Doyle, McBride, Swarts, Hayden, & Gwaltney, 1988). The bags were weighed and the weight of the tissues and bags subtracted. To adjust for baseline, we subtracted the weight on the day before inoculation from each daily weight

of the mucus produced after viral inoculation. The adjusted postinoculation weights were summed to create an adjusted total mucus weight score.

Nasal mucociliary clearance function refers to the effectiveness of nasal cilia in clearing mucus from the nasal passage toward the nasopharynx. Clearance function was assessed by measuring the time required for a dye administered in the nostrils to reach the nasopharynx (Doyle, McBride, Swarts, Hayden, & Gwaltney, 1988). Each daily time was adjusted (by subtracting) for baseline, and the adjusted average time in minutes was calculated across the postinoculation days of the trial.

Volunteers met the objective criteria for having a common cold if they were infected and met disease criteria. They were classified as infected if the inoculation virus was isolated on any of the 5 postinoculation study days or if there was a fourfold or greater rise in virus-specific serum neutralizing antibody titer from before viral exposure to 28 days after exposure. The criteria for disease included a total adjusted mucus weight of at least 10 g or adjusted average mucociliary nasal clearance time of at least 7 min (Cohen et al., 1997).

## Results

### *Concordance of Self-Reports of Illness and Objective Colds*

Twenty-eight percent of the sample met both the self-report and the objective criteria for a cold ( $n = 77$ ). Twelve percent met objective criteria but did not meet self-report criteria ( $n = 32$ ), and 12% met self-report criteria but not objective criteria ( $n = 32$ ). Forty-eight percent met neither the objective nor the self-report criteria ( $n = 135$ ). The kappa was .52 ( $p < .01$ ). According to Fleiss (1981, p. 218), values of kappa between .40 and .75 represent fair to good agreement beyond chance.

### *Interrelations Between Personality Variables*

Pearson correlations were computed as tests of the association among the Big Five personality characteristics. As is made apparent on Table 2, the five personality characteristics were moderately ( $r = .10$  to  $r = .43$ ) correlated with one another.

### *Does Personality Predict Symptom Reporting at Baseline?*

It was hypothesized that Neuroticism would be associated with reporting of more symptoms at baseline. We also speculated that Extraversion and Openness to Experience may be associated with greater symptom reporting. We entered each of the personality characteristics into individual (five separate) logistic regression models predicting self-reports of symptoms at baseline. In each regression model, the standard control variables were entered in a stepwise manner in the first step, followed by the personality

characteristic in the second step. We used seven of the nine standard control variables in these analyses because prechallenge antibodies to the virus and virus type were not relevant prior to inoculation. In the regression models, married participants reported fewer baseline symptoms than unmarried participants did ( $\beta = -0.62, p < .05$ ). Neuroticism was the only personality characteristic to predict self-reports of baseline symptoms such that baseline symptom reports increased with increased Neuroticism ( $\beta = 0.07, p < .01$ ; for the other personality characteristics, all  $ps > .12$ ). To generate an effect size (odds ratios), we reran the same analysis trichotomizing Neuroticism. These odds ratios provided an estimate of how much more likely it was that an outcome (e.g., reporting any baseline symptoms) would occur for those in the top third category of Neuroticism versus for those in the bottom third category of Neuroticism. We again found an overall effect of Neuroticism, Wald(2) = 8.90,  $p < .05$ . Compared with those in the lowest tertile of Neuroticism scores (odds ratio set at 1), those in the second tertile had an odds ratio of 1.94 (95% confidence interval [CI] = 1.08, 3.50), and for those in the third tertile the odds ratio was 2.34 (95% CI = 1.30, 4.24).

### *Does Personality Predict Biases in Postinoculation Symptom Reporting?*

It was hypothesized that Neuroticism would be related to the reporting of more symptoms and of more severe symptoms postinoculation after controlling for objective colds. It was also suggested that Extraversion and Openness to Experience may be associated with reports of more symptoms. We entered each of the personality characteristics into individual linear regression models predicting self-reports of symptom number and symptom severity postinoculation. In these models, we examined which personality characteristics predicted postinoculation symptom reporting independent of their influence on baseline symptom reporting and of the standard control variables. Objective colds and baseline symptoms were entered in the first step, the standard control variables were entered in a stepwise fashion in the second step, and the personality characteristic was entered in the third step. To examine whether a personality characteristic was associated with self-reports of symptoms among both those who did develop and those who did not develop colds, we entered the interaction effect of personality characteristic by objective colds in the last step of the model.

In the regression models, participants with colds reported a greater number of symptoms ( $\beta = .52, p < .01$ ) and more severe symptoms ( $\beta = .52, p < .01$ ) after the inoculation. Participants who had antibodies to the virus before exposure reported fewer symptoms ( $\beta = -.20, p < .01$ ) and less severe symptoms ( $\beta = -.18, p < .01$ ) after the inoculation than did those without the corresponding antibodies, and women reported more symptoms after the inoculation than men did ( $\beta = .12, p < .01$ ). Neuroticism was the only personality characteristic to predict self-reports of a greater number of symptoms ( $\beta = .13, p < .05$ ) and more severe symptoms ( $\beta = .12, p < .05$ ) postinoculation. Neuroticism accounted for an additional 1% of the variance in the models predicting symptom number and symptom severity. The overall  $R^2$  for the symptom number model was .34 and for the symptom severity model was .31. There was no interaction effect of Neuroticism by

Table 2  
*Correlations Between Personality Factors*

Factor	2	3	4	5
1. Agreeableness	—			
2. Conscientiousness	.41*	—		
3. Neuroticism	-.43*	-.27*	—	
4. Extraversion	.28*	.27*	-.38*	—
5. Openness to Experience	.24*	.20*	-.10†	.25*

† $p < .10$  (marginally significant). \* $p < .01$



objective colds, suggesting that Neuroticism was related to reports of more symptoms for those both with and without colds.

In the models with Openness to Experience predicting symptom number and severity, there were no main effects. However, there were interaction effects of Openness to Experience by objective colds in self-reports of symptom number ( $\beta = .72, p < .05$ ) and symptom severity ( $\beta = .67, p < .05$ ). The interaction term accounted for an additional 2% of the variance in the model predicting symptom number and 1% of the variance in that predicting symptom severity. The overall  $R^2$  for the symptom number model was .34 and for the symptom severity model was .31. A median split was used to create a dichotomous openness variable and to examine the nature of the interaction with the number of symptoms reported. Among individuals with objective colds, those who were high in Openness to Experience reported a greater number of symptoms ( $M = 15.8, SD = 7.6$ ) than individuals who were low in Openness to Experience ( $M = 12.8, SD = 8.1$ ),  $t(107) = -1.99, p < .05$ . Among individuals who did not have objective colds, there were no differences in the number of symptoms reported between those high ( $M = 5.1, SD = 5.8$ ) and low ( $M = 6.5, SD = 6.3$ ) in Openness to Experience. The same pattern was found with symptom severity.

### *Does Personality Predict Biases in Illness Reporting?*

We consider these analyses more exploratory in nature. We speculated that Conscientiousness and Openness to Experience may be associated with more reports of illness but had no hypotheses in regard to the remaining three personality factors. We entered each of the personality characteristics into individual logistic regression models predicting self-reports of postinoculation illness. In these models, we controlled for self-reports of symptoms at baseline and postinoculation to examine which personality characteristics predicted reports of illness independent of their influence on symptom reporting. Because self-reports of symptom number and severity are very strongly associated ( $r = .92, p < .01$ ), we decided to control only for symptom number in the models. Objective colds, baseline symptoms, and self-reports of postinoculation symptom number were entered in the first step; the standard control variables were entered in a stepwise fashion in the second step; and the personality characteristic was entered in the third step. In the fourth step of each model, we entered the interaction between the personality characteristic and objective colds to determine whether associations between personality and self-reports of postinoculation illness were found among healthy individuals and those with colds.

In the regression models, participants with colds were more likely to report being ill ( $\beta = 1.32, p < .01$ ). Participants with more symptoms were more likely to report being ill than those with fewer symptoms ( $\beta = 0.21, p < .01$ ). Participants with more than a high school education reported less illness than those with a high school education ( $\beta = -1.17, p < .05$ ), and those with greater body mass reported less illness than those with less body mass ( $\beta = -0.07, p < .05$ ). The higher the scores on Conscientiousness ( $\beta = 0.09, p < .01$ ), Openness to Experience ( $\beta = 0.08, p < .05$ ), and Agreeableness ( $\beta = 0.08, p < .05$ ), the more likely the report of illness. The higher the score on Neuroticism, the less likely the report of illness ( $\beta = -0.08, p < .05$ ).

There was also an interaction effect of Conscientiousness by objective colds ( $\beta = -0.17, p < .05$ ). A median split was used to create a dichotomous conscientiousness variable and to examine the nature of the interaction. Among individuals who did not have objective colds, those high in Conscientiousness ( $n = 88$ , or 53%) were more likely to report illness than those low in Conscientiousness ( $n = 79$ , or 47%),  $\chi^2(1, n = 167) = 5.84, p < .05$ . Among individuals who did have objective colds, there were no differences in illness reporting between those high in Conscientiousness ( $n = 55$ , or 51%) and those low in Conscientiousness ( $n = 54$ , or 51%).

To examine which personality characteristics predicted illness reporting after accounting for the interrelations among them (see Table 2), we ran an additional logistic regression model. Objective colds, baseline symptoms, and self-reports of postinoculation symptom number were entered in the first step; the standard control variables were entered in a stepwise fashion in the second step; the personality characteristics were entered in a stepwise fashion in the third step; and the interactions between the personality characteristics and objective colds were entered in a stepwise fashion in the fourth step of the model.

In this model, Conscientiousness was the only personality characteristic to enter the model. Higher Conscientiousness was associated with more reports of illness ( $\beta = 0.09, p < .01$ ). There was also an interaction effect of Conscientiousness by objective colds ( $\beta = -0.17, p < .05$ ) that followed the same pattern as that found in the individual model. This analysis indicates that the contribution of the other personality characteristics in the individual models can be explained by their overlap with Conscientiousness. To generate an effect size for the association between Conscientiousness and self-reports of illness in individuals without colds ( $N = 167$ ), we reran the model with the Conscientiousness tertiles entered in the third step. We again found an overall effect of Conscientiousness,  $Wald(2) = 8.27, p < .05$ . Compared with those in the lowest tertile of Conscientiousness scores (odds ratio set at 1), the odds ratio for those in the second tertile was 1.88 (95% CI = 0.54, 6.57) and those in the third tertile was 5.24 (95% CI = 1.61, 17.09).

### *Structural Model of Symptom and Illness Reporting*

The results of the regression indicated that Neuroticism is associated with reports of more symptoms at baseline and postinoculation, and Conscientiousness with more reports of illness. Structural equation modeling (SEM; Bentler, 1992) allowed us to test these direct paths in a single model and to examine whether there were indirect relations of Neuroticism and Conscientiousness with symptom and illness reporting.

In our initial model (see Figure 1), we included all of the direct paths connecting Neuroticism and Conscientiousness with symptom reporting at baseline and postinoculation and with postinoculation illness reporting. We also included the indirect (through baseline and postinoculation symptoms) paths between the personality variables and illness reporting. Finally, to control (as in the regressions) for the actual effects of objective illness, we included whether participants had an objective illness (a cold) and tested the direct paths between this measured variable, postinoculation symptoms, and illness, as well as the indirect path from objective colds to symptoms to illness. Although we could have run separate SEM

models to examine the interaction of personality characteristics by objective colds in symptom and illness reporting, there was limited power to run these models.<sup>2</sup> Two indexes were used to assess model fit, the chi-square statistic and the comparative fit index (CFI; Bentler, 1990). A nonsignificant chi-square and a CFI (which can range from 0 to 1.0) greater than .95 generally indicate a good-fitting model.

The test of our initial model resulted in a  $\chi^2(5, N = 276) = 5.98, p = .31$ , and a CFI of 1.0. To produce the most conservative, constrained model (i.e., the one with the fewest paths), we used Wald tests to identify nonsignificant paths. The paths between Neuroticism and illness reporting, Conscientiousness and baseline symptom reporting, and Conscientiousness and postinoculation symptom reporting were dropped and the model was reestimated. The final model resulted in a  $\chi^2(8, N = 276) = 8.56, p = .38$ , and a CFI of 1.0 (see Figure 2).<sup>3</sup> In this model, only Neuroticism was associated with reporting a greater number of symptoms at baseline and postinoculation ( $p < .01$ ). Conscientiousness was associated with more reports of illness ( $p < .01$ ). Objective colds were associated with reporting more symptoms and illness ( $p < .01$ ). In terms of indirect effects, Neuroticism was associated with greater illness reporting through postinoculation symptom reporting (standardized indirect effect coefficient = .08,  $p < .01$ ). Objective colds also influenced self-reports of illness through reports of more symptoms (standardized indirect effect coefficient = .28,  $p < .01$ ).

In the final model, Neuroticism accounted for 3% of the variance in baseline symptoms and 2% of the variance in postinoculation symptom number. Conscientiousness accounted for 2% of the variance in postinoculation illness reports. Neuroticism and objective colds together accounted for 15% of the variance in self-reports of postinoculation symptoms. Conscientiousness, Neuroticism, objective colds, and self-reports of symptoms together accounted for 28% of the variance in self-reports of illness.

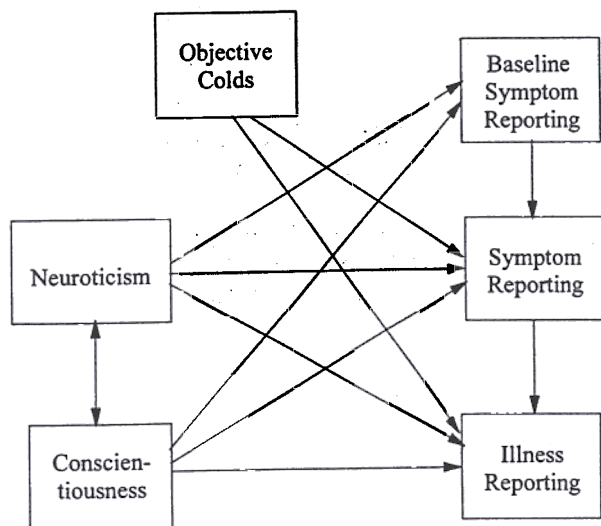


Figure 1. Hypothesized structural equation model.

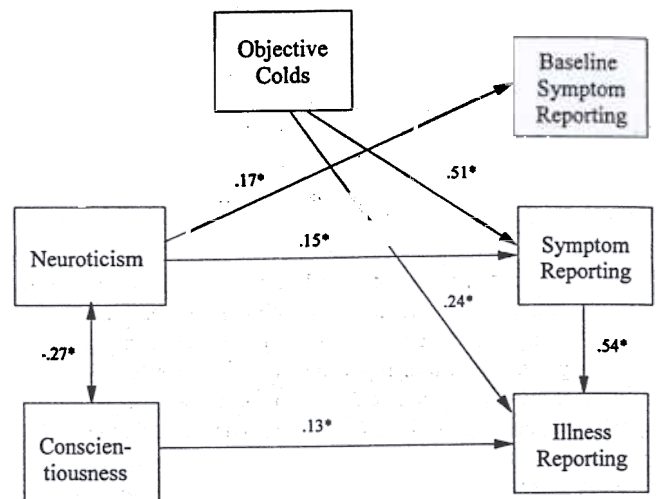


Figure 2. Final structural model. \* $p < .01$ .

### Discussion

#### Are Self-Report Measures of Disease Biased?

Self-reports are often used as the sole criterion for disease. In fact, it is a common research practice to use physician diagnosis, which is based primarily on the presentation of symptoms to the physician, as the objective disease criterion (Cohen, Tyrrell, & Smith, 1991; Macintyre & Pritchard, 1989). In this study, where disease was objectively assessed, the degree of correspondence between self-report and objective criteria for colds was lower than that found in those studies. The level of agreement between subjective and objective criteria found in the present study suggests that although self-reports are moderately associated with the objective disease criteria, there are other processes (including psychological ones) that contribute to the perception that one is experiencing cold-related symptoms and illness.

#### Neuroticism and Biases in Symptom and Illness Reporting

We have provided further evidence that the association between neuroticism and reports of more symptoms is not based on underlying physical disease. As hypothesized, neuroticism was related to the reporting of symptoms when individuals were physically healthy, specifically at baseline. This relation was not found in a previous viral inoculation study (Cohen et al., 1995), although in the present study there was greater power to detect a relation

<sup>2</sup> A sample of approximately 200 participants is recommended for small-to medium-sized SEM models (Ullman, 1996). Thus, there would be limited power to estimate a model of individuals with colds ( $N = 109$ ).

<sup>3</sup> In SEM, measured variables are denoted by rectangles. Paths with single-headed arrows represent standardized regression paths. Paths with double-headed arrows represent correlation coefficients.

between these variables.<sup>4</sup> Although the variance accounted for by neuroticism in the SEM model was small, the odds ratios showed that individuals scoring in the top third of Neuroticism on our Big Five adjective scale were more than two times as likely to report symptoms at baseline than those in the bottom third of Neuroticism. Consistent with the previous study (Cohen et al., 1995), neuroticism was associated with biases in the reporting of post-inoculation symptoms in individuals with colds. It was also associated with the reporting of unfounded symptoms in individuals without colds. Although we found neuroticism was not directly related to illness reporting after controlling for objective illness, it was indirectly associated with biases in the reporting of illness through greater symptom reporting. In terms of effects, the percentage of variance accounted for by neuroticism was small.

Multiple mechanisms have been proposed to explain the relation between neuroticism and biases in symptom reporting that are expected to operate in both healthy and sick individuals. One type of explanation suggests that those high in neuroticism may report unfounded symptoms because they are more self-focused and attentive to their physical states than those low in neuroticism. Another type of explanation suggests that biases in symptom reporting arise from the tendency for those high in neuroticism to interpret and recall somatic experiences in a negative manner. These explanations suggest that neuroticism should be associated not only with biases in symptom reporting, but also with a bias toward defining oneself as ill and making possibly hypochondriacal assessments of illness. Recent studies show that neuroticism is associated with somatization, or the chronic tendency to attribute symptoms for which there is no organic cause to physical illness and to seek medical help for them (Deary, Clyde, et al., 1997; Deary, Scott, & Wilson, 1997; Russo, Katon, Lin, & Von Korff, 1997). However, these studies do not assess the reporting of specific illnesses. In this study, there was support for an indirect relation between neuroticism and illness reporting through post-inoculation symptom reporting, although neuroticism did not directly predict the reporting of illness. These findings suggest that neuroticism is related to the reporting of symptoms and illness through attentional processes rather than the tendency to interpret and recall somatic experiences in a negative manner.

Although the relation between neuroticism and reports of more symptoms held for individuals with and without colds, we found that another personality dimension, openness, was related to reports of more symptoms only in individuals with colds. Openness, which is also referred to as Openness to Experience as a Big Five factor, reflects traits such as being curious, creative, and sensitive to feelings and experiences (Carver & Scheier, 1988). It has been suggested that openness is related to attention to bodily sensations and that somatic attention is associated with increased symptom reporting (Kirmayer et al., 1994). Our findings suggest that openness is related to an increased sensitivity to bodily sensations when individuals are experiencing actual disease rather than a general tendency to report symptoms among healthy persons.

### *Conscientiousness and Biases in Illness Reporting*

This study provides preliminary evidence that conscientiousness is related to a bias toward reporting illness among persons not meeting clinical criteria for disease. Although the variance accounted for by conscientiousness in the SEM model was small, the

odds ratios showed that individuals scoring in the top third of Conscientiousness on our Big Five adjective scale were more than five times as likely to report illness than those in the bottom third of Conscientiousness. Conscientiousness reflects qualities such as being cautious, responsible, and thorough and striving toward goals; it also captures elements of agreeableness (Carver & Scheier, 1988). A general interpretation of our findings is that conscientious individuals may use lower criteria to establish illness because they are more cautious about their health and eager to report illness so they may obtain an early diagnosis and treatment. That there was no indirect association through symptom reporting suggests that the relation between conscientiousness and illness reporting was based on processes that are independent of those involved in perceiving and reporting symptoms.

Cognitive processes involved in illness reporting include the use of illness schemas and disease prototypes to determine whether a set of symptoms is representative of a specific illness (Bishop, 1991). Schemas for colds are likely to be accessible given that colds are common illnesses. Those high in conscientiousness may use these schemas to cluster and label their symptoms before complete signs of illness are apparent. Individuals high in conscientiousness may also search for symptoms, which are correlated or symmetric (with the illness label), and neglect changes in the symptom course over time (Leventhal & Diefenbach, 1991; Pennebaker, 1982). This tendency may be greater with conscientious individuals because they tend to be more vigilant when searching for signs of illness (Kirmayer et al., 1994). Another process involved in defining oneself as ill is the use of social comparison information to assess the threat associated with a set of symptoms (Croyle & Jemmott, 1991; Sanders, 1982). Those high in conscientiousness may be more likely to seek out or use this information so they may confirm the label they assigned to a symptom set and initiate care seeking. As few empirical studies have examined illness reporting in actual illness contexts, further research is needed to assess whether these mechanisms link conscientiousness to the biases we report.

Recent attention has been drawn to conscientiousness as a personality dimension that is related to health-promoting behavior and health-relevant personality constructs (Marshall, Wortman, Vickers, Kusulas, & Hervig, 1994). Studies have found that conscientiousness is related to greater physical fitness, less substance use, and reduced risk-taking behavior (Booth-Kewley & Vickers, 1994; Friedman et al., 1995; Hogan, 1989). Conscientiousness is positively related to health-relevant personality constructs, including dispositional optimism and locus of control (Marshall et al., 1994). There may also be some overlap with the monitoring-blunting personality dimension, as high monitors-low blunters tend to seek care for less severe medical problems and take fewer health risks than do low monitors-high blunters (Miller, Brody, & Summerton, 1988). It appears that conscientious individuals attend to their physical health more and take fewer health risks, which may explain why they also have lower criteria for illness in the present study. Given the exploratory nature of these findings, however, replication of these results is needed.

<sup>4</sup> The previous study had a smaller sample size ( $N = 70$ ), and thus fewer individuals reported symptoms at baseline in that study ( $N = 27$ ) than in this study ( $N = 145$ ).



### Aspects of the Paradigm

There are aspects of this experimental paradigm that may limit the generalizability of the findings. In contrast to what they would experience in naturalistic settings, individuals in viral inoculation studies are encouraged to attend to their physical states through regular reporting of symptoms and interactions with health care professionals. They also have greater expectations of becoming sick than they would in naturalistic environments, although symptom reporting at baseline is comparable with reporting in a naturalistic environment. Demand characteristics or social desirability factors may contribute to the associations found between personality and biases in postinoculation symptom and illness reporting. For example, conscientious individuals may be more inclined to report illness so they may appear responsible and cautious about their health. In this setting, participants are also aware of the disease to which they have been exposed and report on specific, illness-related symptoms. The processes underlying symptom reporting in this setting may differ from those underlying the reporting of symptoms in naturalistic studies, which tend to measure vague and diffuse symptoms. The use of measures of a specific illness reduces the potential for psychological bias in this setting (Mechanic, 1972). Finally, it is important to examine whether our findings generalize across different forms of illness. For example, with cancer and cardiovascular disease there is a longer time lag between the contraction of the disease and the appearance of symptoms than in the case of colds, and thus different personality factors may be relevant to biases in reporting behavior in these contexts.

### Conclusions

In this study, evidence was provided for the ability of personality factors to predict biases in self-report measures of illness. Neuroticism was associated with reporting symptoms in healthy individuals at baseline and postinoculation after controlling for objective illness. Neuroticism and Openness to Experience were also related to biases in symptom reporting in individuals experiencing illness. The relations between Neuroticism and the reporting of symptoms and illness appear to be attributable to attentional processes involved in the perception of symptoms rather than the tendency to interpret somatic experiences in a negative manner. Although individuals who report unfounded illness are generally characterized as emotionally distressed (Kirmayer et al., 1994), our findings suggest that individuals high in Conscientiousness may report unfounded illness because of their concerns about maintaining better physical health. That different personality factors were associated with biases in symptom and illness reporting supports theoretical speculation that different psychological processes are involved in different stages of illness representation.

### References

- Barsky, A. J., & Klerman, G. L. (1983). Overview: Hypochondriasis, bodily complaints, and somatic styles. *American Journal of Psychiatry*, *140*, 273-283.
- Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, *107*, 238-246.
- Bentler, P. M. (1992). *EQS: Structural equations program manual*. Los Angeles: Multivariate Software.
- Bishop, G. D. (1991). Understanding the understanding of illness: Lay disease representations. In J. A. Skelton & R. T. Croyle (Eds.), *Mental representation in health and illness* (pp. 32-59). New York: Springer-Verlag.
- Booth-Kewley, S., & Vickers, R. R. (1994). Associations between major domains of personality and health behavior. *Journal of Personality*, *62*, 281-298.
- Brown, K. W., & Moskowitz, D. S. (1997). Does unhappiness make you sick? The role of affect and neuroticism in the experience of common physical symptoms. *Journal of Personality and Social Psychology*, *72*, 907-917.
- Carver, C. S., & Scheier, M. F. (1988). *Perspectives on personality*. Boston: Allyn & Bacon.
- Cioffi, D. (1991). Beyond attentional strategies: A cognitive-perceptual model of somatic interpretation. *Psychological Bulletin*, *109*, 25-41.
- Cohen, S., Doyle, W. J., Skoner, D. P., Fireman, P., Gwaltney, J. M., Jr., & Newsom, J. T. (1995). State and trait negative affect as predictors of objective and subjective symptoms of respiratory viral infections. *Journal of Personality and Social Psychology*, *68*, 159-169.
- Cohen, S., Doyle, W. J., Skoner, D. P., Rabin, B. S., & Gwaltney, J. M., Jr. (1997). Social ties and susceptibility to the common cold. *Journal of the American Medical Association*, *277*, 1940-1944.
- Cohen, S., Tyrrell, D. A. J., & Smith, A. P. (1991). Psychological stress and susceptibility to the common cold. *New England Journal of Medicine*, *325*, 606-612.
- Cohen, S., & Williamson, G. M. (1991). Stress and infectious disease in humans. *Psychological Bulletin*, *109*, 5-24.
- Costa, P. T. (1987). Influence of the normal personality dimension of neuroticism on chest pain symptoms and coronary artery disease. *American Journal of Cardiology*, *60*, 20J-26J.
- Costa, P. T., & McCrae, R. R. (1985). Hypochondriasis, neuroticism, and aging: When are somatic complaints unfounded? *American Psychologist*, *40*, 19-28.
- Costa, P. T., & McCrae, R. R. (1987). Personality assessment in psychosomatic medicine: Value of a trait taxonomy. In T. Wise & G. Fava (Eds.), *Advances in psychosomatic medicine* (pp. 71-82). Basel, Switzerland: Karger.
- Croyle, R. T., & Jemmott, J. B. (1991). Psychological reactions to risk factor testing. In J. A. Skelton & R. T. Croyle (Eds.), *Mental representation in health and illness* (pp. 85-103). New York: Springer-Verlag.
- Deary, I. J., Clyde, Z., & Frier, B. M. (1997). Constructs and models in health psychology: The case of personality and illness reporting in diabetes mellitus. *British Journal of Health Psychology*, *2*, 35-54.
- Deary, I. J., & Frier, B. M. (1995). Personality, stress, and diabetes. In C. D. Spielberger & I. G. Sarason (Eds.), *Series in stress and emotion: Anxiety, anger and curiosity* (Vol. 15, pp. 33-49). Washington, DC: Taylor & Francis.
- Deary, I. J., Scott, S., & Wilson, J. A. (1997). Neuroticism, alexithymia, and medically unexplained symptoms. *Personality and Individual Differences*, *22*, 551-564.
- Doyle, W. J., McBride, T. P., Swartz, J. D., Hayden, F. G., & Gwaltney, J. M., Jr. (1988). The response of the nasal airway, middle ear, and eustachian tube to provocative rhinovirus challenge. *American Journal of Rhinology*, *2*, 149-154.
- Farr, B. M., Gwaltney, J. M., Jr., Hendley, J. O., Hayden, F. G., Naclerio, R. M., McBride, T., Doyle, W. J., Sorrentino, J. V., Riker, D. K., & Proud, D. (1990). A randomized controlled trial of glucocorticoid prophylaxis against experimental rhinovirus infection. *Journal of Infectious Disease*, *162*, 1173-1177.
- Fleiss, J. L. (1981). *Statistical methods for rates and proportions* (2nd ed.). New York: Wiley.
- Friedman, H. S., Tucker, J. S., Schwartz, J. E., Martin, L. R., Tomlinson-Keasey, C., Wingard, D. L., & Criqui, M. H. (1995). Childhood con-



- scientiousness and longevity: Health behaviors and cause of death. *Journal of Personality and Social Psychology*, 68, 696-703.
- Goldberg, L. R. (1992). The development of markers for the Big-Five factor structure. *Psychological Assessment*, 4, 26-42.
- Gray, J. A. (1982). *The neuropsychology of anxiety: An enquiry into the functions of the septo-hippocampal system*. New York: Oxford University Press.
- Gwaltney, J. M., Jr., Colonna, R. J., Hamparian, V. V., & Turner, R. B. (1989). Rhinovirus. In N. J. Schmidt & R. W. Emmons (Eds.), *Diagnostic procedures for viral, rickettsial, and chlamydial infections* (6th ed., pp. 579-614). Washington, DC: American Public Health Association.
- Harkins, S. W., Price, D. D., & Braith, J. (1989). Effects of extraversion and neuroticism on experimental pain, clinical pain, and illness behavior. *Pain*, 36, 209-218.
- Hepburn, D. A., Deary, I. J., MacLeod, K. M., & Frier, B. M. (1994). Structural equation modeling of symptoms, awareness and fear of hypoglycemia, and personality in patients with insulin-treated diabetes. *Diabetes Care*, 17, 1273-1280.
- Hogan, J. (1989). Personality correlates of physical fitness. *Journal of Personality and Social Psychology*, 56, 284-288.
- Kirmayer, L. J., Robbins, J. M., & Paris, J. (1994). Somatoform disorders: Personality and the social matrix of somatic distress. *Journal of Abnormal Psychology*, 103, 125-136.
- Larsen, R. J. (1992). Neuroticism and selective encoding and recall of symptoms: Evidence from a combined concurrent-retrospective study. *Journal of Personality and Social Psychology*, 62, 284-288.
- Leventhal, H., & Diefenbach, M. (1991). Active side of illness cognition. In J. A. Skelton & R. T. Croyle (Eds.), *Mental representation in health and illness* (pp. 247-272). New York: Springer-Verlag.
- Lipowski, Z. J. (1988). Somatization: The concept and its clinical application. *American Journal of Psychiatry*, 145, 1358-1368.
- Macintyre, S., & Pritchard, C. (1989). Comparisons between the self-assessed and observer-assessed presence and severity of colds. *Social Science and Medicine*, 29, 1243-1248.
- Marshall, G. N., Wortman, C. B., Vickers, R. R., Jr., Kusulas, J. W., & Hervig, L. K. (1994). The five-factor model of personality as a framework for personality-health research. *Journal of Personality and Social Psychology*, 67, 278-286.
- Mechanic, D. (1972). Social psychologic factors affecting the presentation of bodily complaints. *New England Journal of Medicine*, 286, 1132-1139.
- Miller, S. M., Brody, D. S., & Summerton, J. (1988). Styles of coping with threat: Implications for health. *Journal of Personality and Social Psychology*, 54, 142-148.
- Pennebaker, J. (1982). *The psychology of physical symptoms*. New York: Springer-Verlag.
- Pennebaker, J., & Watson, D. (1991). The psychology of somatic symptoms. In L. J. Kirmayer & J. M. Robbins (Eds.), *Current concepts of somatization* (pp. 21-36). Washington, DC: American Psychiatric Press.
- Philips, H. C., & Jahanshahi, M. (1985). The effects of persistent pain: The chronic headache sufferer. *Pain*, 21, 163-176.
- Robbins, A. S., Spence, J. T., & Clark, H. (1991). Psychological determinants of health and performance: The tangled web of desirable and undesirable characteristics. *Journal of Personality and Social Psychology*, 61, 755-765.
- Russo, J., Katon, W., Lin, E., & Von Korff, M. (1997). Neuroticism and extraversion as predictors of health outcomes in depressed primary care patients. *Psychosomatics*, 38, 339-348.
- Sanders, G. S. (1982). Social comparison and perceptions of health and illness. In G. S. Sanders & J. Suls (Eds.), *Social psychology of health and illness* (pp. 129-157). Hillsdale, NJ: Erlbaum.
- Shekelle, R. B., Vernon, S. W., & Ostfeld, A. M. (1991). Personality and coronary heart disease. *Psychosomatic Medicine*, 53, 176-184.
- Stelmack, R. M. (1990). Biological bases of extraversion: Psychophysiological evidence. *Journal of Personality*, 58, 293-311.
- Ullman, J. B. (1996). Structural equation modeling. In B. G. Tabachnick & L. S. Fidell (Eds.), *Using multivariate statistics* (3rd ed., pp. 709-812). New York: HarperCollins.
- Wade, J. B., Dougherty, L. M., Hart, R. P., Raffii, A., & Price, D. D. (1992). A canonical correlation analysis of the influence of neuroticism and extraversion on chronic pain, suffering, and pain behavior. *Pain*, 51, 67-73.
- Watson, D. (1988). Intraindividual and interindividual analyses of positive and negative affect: Their relation to health complaints, perceived stress, and daily activities. *Journal of Personality and Social Psychology*, 54, 1020-1030.
- Watson, D., & Clark, L. A. (1984). Negative affectivity: The disposition to experience aversive emotional states. *Psychological Bulletin*, 96, 465-490.
- Watson, D., & Pennebaker, J. W. (1989). Health complaints, stress, and distress: Exploring the central role of negative affectivity. *Psychological Review*, 96, 234-254.
- Wiebe, D. J., & Smith, T. W. (1997). Personality and health: Progress and problems in psychosomatics. In R. Hogan, J. Johnson, & S. Briggs (Eds.), *Handbook of personality psychology* (pp. 892-908). New York: Academic Press.

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