

Perceptual Consequences of an Illness-Concern Induction and Its Relation to Hypochondriacal Tendencies

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This article examines the perceptual consequences of activating illness concern as a function of hypochondriacal tendencies. In 2 independent samples, hypochondriacal tendencies were associated with slower reaction times on a modified emotional Stroop task when the stimulus words were illness related, but only when illness concern was activated. Moreover, these findings emerged when hypochondriacal tendencies were defined as a sensitivity to bodily sensations. When defined as illness preoccupation and fear, hypochondriacal tendencies were associated with a generalized pattern of perseveration to all stimuli when health concern was activated. Finally, the results persisted even after statistically controlling for state anxiety. Findings are discussed within the context of an activation hypothesis and highlight the importance of the operational definition and assessment of hypochondriacal tendencies when examining perceptual biases.

Key words: perceptual bias, Stroop, hypochondriasis, activation

I have a tumor in my head the size of a basketball. I can feel it when I blink.

—Woody Allen, *Hannah and Her Sisters*

Numerous and complex consequences are associated with having exaggerated or unfounded symptoms and illness concerns. In the clinical population, such beliefs can manifest themselves in the form of *hypochondriasis*, which has been defined as illness preoccupation and worry due to the misinterpretation of bodily symptoms (*Diagnostic and Statistical Manual of Mental Disorders*, American Psychiatric Association, 1994; Kellner, 1986; Kenyon, 1978; Warwick & Salkovskis, 1989). Despite the somatic emphasis, such experiences are presumed to be largely psychological in their origin and are subsumed by the somatoform disorders. Epidemiological data suggest that only 4%–5% of the general population exhibits somatoform symptoms (e.g., Escobar, Burnam, Karno, Forsythe, & Golding, 1987), yet these individuals make extensive use of medical care services (Monson & Smith, 1983; Wagner & Curran, 1984) and account for upwards of 50% of adult ambulatory health care costs (Collyer, 1979).

Individuals in the nonclinical population generally show bias toward believing they are healthy unless confronted with over-

whelming evidence to the contrary. Weinstein (1984, 1987), for example, has shown that most people assess their risk for illness as lower than average. Indeed, when “normal” individuals have a health fear activated, they often avoid actions that may facilitate the detection of a health threat and may be temporarily unwilling to undertake protective acts (e.g., Leventhal & Watts, 1966; Millar & Millar, 1995). In contrast, individuals exhibiting subclinical forms of hypochondriasis, hereafter referred to as *hypochondriacal tendencies*,¹ evidence a strong bias toward believing they are unhealthy, and this can heighten the incidence of self-reported illness. (Neuroticism also has been linked to the reporting of unfounded symptoms; Ellington & Wiebe, 1999; Feldman, Cohen, Doyle, Skoner, & Gwaltney, 1999; Pennebaker, 1982; Watson & Pennebaker, 1989.) People exhibiting hypochondriacal tendencies are quick to adopt illness beliefs, and they seek out medical information to validate these beliefs (Barsky & Klerman, 1983; Kellner, 1986; Warwick, 1989). Because a critical distinction between those exhibiting hypochondriacal tendencies and those with more normative illness beliefs is their readiness to adopt illness beliefs and concerns, it is important to examine the consequences of being confronted with an illness or symptom.

In this article, we examine the perceptual consequences of an illness-concern induction (activation) made salient in a brief health examination. Perceptual markers of illness beliefs have been discussed previously within the context of more comprehensive models (see Cioffi, 1991; Leventhal et al., 1997; Leventhal, Meyer, & Nerenz, 1980). The present study adds to this work by quantifying a perceptual “cost” in terms of reaction time (RT) and by emphasizing individual differences in illness belief acquisition by considering the individual’s level of hypochondriacal tendencies.

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This research was supported in part by a Cahill Grant from the University of North Carolina at Wilmington. Special thanks go to Ashley Neighbors, Holly Williamson, Aimee Boner, Laura Lupton, and Michele Mathis for their assistance with data collection, coding, and data entry. Portions of this article were presented at the 10th annual convention of the American Psychological Society, Washington, DC, June 1998, and at the 12th annual convention of the American Psychological Society, Miami, Florida, June 2000.

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¹ When nonclinical populations are considered, the term *hypochondriacal tendencies* is preferred over *hypochondriasis* (cf. Barsky, Cleary, Sarnie, & Klerman, 1993).

Hypochondriacal Tendencies and Their Relation to Perceptual Processes

An important and well-established finding in the empirical literature is that, with regard to illness-related behaviors, individuals are highly responsive to internal representations and subjective constructions of illness and symptoms (e.g., Bishop & Converse, 1986; Cioffi, 1991; Lau & Hartman, 1983; Leventhal et al., 1997). Although influenced by a variety of factors, researchers have identified attention as a common pathway through which illness beliefs are formed. For example, hypochondriacal tendencies have been described as selective attention to physical symptoms in conjunction with a negative affective experience (e.g., Barsky & Klerman, 1983). In attempting to explain the development of this heightened somatic attention, it has been hypothesized that individuals differ with regard to their perceptual sensitivity such that those evidencing hypochondriacal tendencies are better able to detect and report somatic sensations, and this results in a bias toward perceiving various bodily symptoms (Barsky & Klerman, 1983; Barsky, Wyshak, & Klerman, 1990; Kirmayer, Robbins, & Paris, 1994). An explanation that relies, at least in part, on perceptual processes is consistent with explanatory accounts applied to more normative experiences of illness belief acquisition (e.g., Cioffi, 1991; Leventhal, 1970; Leventhal et al., 1980, 1997). However, to date, few studies have empirically assessed the perceptual concomitants of hypochondriacal tendencies, and among these studies, the findings are equivocal.

Two studies have suggested the presence of a heightened perceptual sensitivity in hypochondriacs. Hanback and Revelle (1978) found that hypochondriasis was associated with discrimination between two light flashes presented in rapid succession. In a study that more directly assessed perceptual processes relevant to health, Hitchcock and Matthews (1992) found that those with hypochondriacal tendencies were faster to correctly recognize illness words relative to neutral words. However, equally prominent in the literature are studies suggesting that hypochondriacs do not evidence a heightened perceptual sensitivity. For example, hypochondriacal tendencies do not predict awareness of resting heartbeat (Barsky, Brener, Coeytaux, & Cleary, 1995; Barsky et al., 1998), tactile sensitivity (Haenen, Schmidt, Schoenmakers, & van den Hout, 1997), nor do people with these tendencies perceive more health-related words when they view difficult-to-read words (Brown, Kosslyn, Delamater, Fama, & Barsky, 1999). Moreover, findings have also been inconsistent in the areas of broader somatization tendencies and the perception of physical pain (see Kellner, 1992; Kirmayer & Robbins, 1991).

The inconsistent findings with regard to hypochondriasis stand in marked contrast to the established literature for other clinical disorders showing that perceptual biases direct attention toward threatening, emotionally relevant stimuli (MacLeod & Matthews, 1991; Matthews & Mackintosh, 1998; McNally, 1990, 1994; Wells & Matthews, 1994).² This literature has established that perceptual biases are an important feature of disorders such as phobias (Lavy & van den Hout, 1993; Watts, McKenna, Sharrock, & Trezise, 1986), generalized anxiety disorder (Matthews & MacLeod, 1985; Mogg, Matthews, & Weinman, 1989), and panic disorder (Ehlers, Margraf, Davies, & Roth, 1988), as well as depression (Gotlib & Cane, 1987; Gotlib & McCann, 1984; Segal, Gemar, Truchon, Guirguis, & Horowitz, 1995). If similar perceptual biases are also

involved in initiating and maintaining hypochondriacal tendencies, then the inconsistencies in the literature to date may be due to other factors.

One factor contributing to the inconsistent findings may be the broad range of characteristic features that have been associated with hypochondriasis. It is possible that different aspects of the hypochondriacal experience are differentially related to perceptual biases. Two aspects of hypochondriacal thinking that have been articulated in the literature and for which separate measures exist are (a) illness preoccupation and worry and (b) a sensitivity to bodily sensations (e.g., Barsky, 1979, 1992; Barsky & Klerman, 1983; Kellner, 1986; Pilowsky, 1967). The Whitely Index (Pilowsky, 1967) is a validated self-report measure that assesses illness preoccupation and fear using items with high face validity that directly ask whether the respondent worries excessively about his or her health. Alternatively, the Somatosensory Amplification Index (SAMPI; Barsky, Wyshak, & Klerman, 1992) is a self-report index of sensitivity to a variety of bodily sensations, including an assessment of how quickly one detects hunger contractions and how one responds to sudden noises. Because the SAMPI emphasizes a generalized (rather than a health-specific) perceptual sensitivity, this measure has decidedly less face validity with regard to the construct of hypochondriacal tendencies. Thus, an important question is whether different aspects of hypochondriacal functioning (sensitivity to bodily sensations vs. illness preoccupation and fear) have different perceptual consequences.

A second factor to consider is the specific conditions under which perceptual biases associated with hypochondriacal thinking might emerge. For example, although perceptual biases may not be evidenced at baseline, they might emerge when illness concerns have been activated. This explanation assumes that the relation between hypochondriacal tendencies and perception is dynamic and can be influenced by directing one's attention to somatic experiences. Some research supports this idea. For example, Schmidt, Wolfs-Takens, Oosterlaan, and van den Hout (1994) instructed students to focus attention on bodily sites and to rate the intensity of possible symptoms related to those sites. Compared with controls, those attending to the bodily sites reported increased incidence and severity of symptoms (see also Pennebaker & Skelton, 1981). It is therefore possible that health-relevant perceptual biases among hypochondriacs may be more observable when individuals direct their attention to somatic experiences (i.e., an activation hypothesis for hypochondriasis; see Persons & Miranda, 1992, for a similar model posited for depression).

The Present Research

Two studies are herein reported in which illness concern is experimentally manipulated through a physical exam and exposure to a new symptom (high blood pressure). Because Cioffi (1991) has shown that the content of attention determines whether the symptom will be distressing to the individual, we explicitly made

² Anxiety disorder patients can also demonstrate a preoccupation with or fear of somatic stimuli, but this differs from the person with hypochondriasis who fears symptoms because they are interpreted as indicating the presence of an illness. On the other hand, the anxious individual's focus on symptoms is more specific to the onset of a panic attack. Nevertheless, the hypothesized role for perception is similar (see Salkovskis, 1996).

the health activation negative to induce some degree of distress. Barsky and Klerman (1983) have argued that new information about an illness or symptom can result in "transient hypochondriasis" (p. 274), and that the induction (i.e., activation) of illness concern should allow for the detection of perceptual biases among those exhibiting hypochondriacal tendencies (see also Cohen, Eckhardt, & Schagat, 1998; Eckhardt & Cohen, 1997).

To assess the perceptual consequences of the illness-concern induction, we drew from the expanding literature involving the emotional Stroop task (see Williams, Matthews, & MacLeod, 1996). In this task, participants who differ on an affective trait are asked to name the color (i.e., the color ink that the word is written in, e.g., blue) of both affectively and nonaffectively valenced words, with response latency (the time it takes participants to respond) functioning as the dependent variable. The accumulated data indicate that, relative to control participants, emotionally disordered participants demonstrate longer color-naming latencies to emotion- or threat-related words (e.g., Eckhardt & Cohen, 1997; Foa, Feske, Murdock, Kozak, & McCarthy, 1991; Matthews & MacLeod, 1985; Segal et al., 1995).

The Stroop task used here is similar to the emotional Stroop task in that participants are asked to name the color of a word, and response latency is recorded. However, in our studies, the words to be used were illness related and neutral in content. Consistent with the broader literature on emotional disorders, we predicted that the incidence of hypochondriacal tendencies would relate positively to reaction time (RT) on the Stroop task (i.e., longer RTs) but only when the stimulus words were illness related and only when illness concerns were activated (i.e., an activation hypothesis that results in a three-way interaction effect between word content, hypochondriacal tendencies, and level of activation). This pattern of data would suggest that when illness concerns have been activated, individuals evidencing hypochondriacal tendencies allocate attentional resources to task-irrelevant, illness-specific stimuli, and this attentional allocation results in tangible negative consequences for performance. A final question we addressed was whether different aspects of the hypochondriacal experience are differentially related to perceptual biases. *Hypochondriacal thinking* is defined here as (a) illness preoccupation and worry and (b) a sensitivity to bodily sensations.

Study 1

Method

Participants

In the Spring and Fall semesters of 1997, 116 college students were recruited from several psychology classes over a 1-year period and assigned to either a control ($n = 65$) or experimental ($n = 51$) condition. Participants in the control condition were 21 men and 44 women ages 17–27 ($M = 20.4$, $SD = 2.2$). As a result of a manipulation check (described below), 5 individuals were removed from the experimental condition, leaving 46 participants (16 men and 30 women) ages 18–22 ($M = 18.9$, $SD = 1.1$).

Measures

Whitely Index. This 14-item scale assesses illness preoccupation and fear (Pilowsky, 1967). These constructs are presumed to be stable, achieving test-retest figures of .81 over an 18-week period. Responses were

based on a 5-point Likert scale, with 0 denoting *not at all* and 4 denoting *a great deal* (e.g., Beaber & Rodney, 1984; Hanback & Revelle, 1978; Pilowsky, 1978). Scores can range from 0 to 56 (14 items \times 4 ratings), with higher scores corresponding to more hypochondriacal tendencies.

SAMPI. The five-item SAMPI is a self-report index that quantifies respondents' sensitivity to bodily sensations such as hunger contractions and to other neutral and noxious stimuli (Barsky et al., 1990). This scale assesses a stable pattern of functioning, and it has achieved a test-retest reliability of .85 over a 28-day interval (Barsky et al., 1990). Responses are based on a 5-point Likert scale, with 0 denoting *not at all* and 4 denoting *extremely*. Scores can range from 0 to 20 (5 items \times 4 ratings), with higher scores corresponding to greater hypochondriacal tendencies.

Modified Stroop task. Participants were instructed to identify whether the color of the target word matched that of the primer word that immediately preceded it. The target words were 40 illness-relevant words (e.g., *HIV*, *T-cells*, *patient*) and 40 neutral control words matched for phonetic and visual similarities with the illness-relevant words (e.g., *CIA*, *T-scope*, *patent*). A post hoc evaluation also revealed that the illness and neutral words did not differ significantly with regard to word frequency ($t = -.49$, $p > .10$). All of the target words were presented in one of five colors: red, purple, blue, green, or yellow. The primer words corresponded to the five possible colors of the target: *red*, *purple*, *blue*, *green*, and *yellow*. All stimuli were presented on a 15-inch VGA color monitor with a 60-Hz refresh rate controlled by an 80-386 microcomputer using the DOS operating system. The resolution of the monitor was 640 \times 480. The stimuli were centered on the monitor in IBM default text at twice the standard size.

Each session consisted of 12 practice trials and 80 experimental trials. A trial consisted of a fixation point presented for 500 ms, followed by the name of the primer color printed in white (e.g., *blue*). The primer remained on the screen for 800 ms, followed by a 200-ms blank screen, followed by the target word (e.g., *patient*), whose color may or may not have matched that of the primer color. The participant's task was to judge whether the target word was presented in the same color as the primer color name. The target word remained on the screen until the participant pressed either the *m* or *x* key on the computer keyboard to indicate his or her response. The key indicating a positive response was randomly chosen for each participant. Negative trials were randomly presented with a probability of .50. Illness and neutral words were presented randomly. RTs were recorded by the computer, and the Stroop instructions and procedure were fully computerized.

Procedure

Students were recruited to take part in a study advertised as "Health and computer game performance" and were assigned to either an experimental or control condition.³ The experimental condition involved the activation of illness concern whereby participants were given a brief medical exam that included questions about their health history followed by a pulse and blood pressure (BP) reading by a trained research assistant wearing a white lab coat. Participants were then told that although their pulse was "normal" their blood pressure was "dangerously high" and that they "would need to set up an appointment at the [university] health center following the experiment." Elevated BP was used because it represents a potentially serious symptom that could plausibly go undetected (e.g., Baumann & Leventhal, 1985). Participants then completed the Stroop task. Participants in the control condition were not given a "medical exam" to avoid activating illness concern prior to the Stroop task. However, they did provide information regarding their health history later in the experiment. After completing the Stroop task, all participants completed the Whitely Index and the SAMPI. Two manipulation checks were then used.

³ The control and experimental conditions were actually run as two separate experiments, but are here combined to facilitate their presentation.

First, participants rated the extent to which each illness-related word from the Stroop task resulted in anxiety/fear using a 0 (*not at all*) to 3 (*extremely*) scale. After being fully debriefed, in a second manipulation check participants in the experimental condition indicated whether they believed the BP feedback, using a 0 (*not at all*) to 5 (*completely*) rating. Those indicating no belief in the feedback (5 out of the 51 participants who gave a rating of 0) were excluded from the experimental group.⁴ All participants were run individually, with the procedure lasting 1 hr. No one reported any lasting difficulty from the induction of illness concern, and at the conclusion of the study everyone was given a fact sheet on BP, information on the health services provided by the university health center, and an opportunity to contact the researchers or the chair of the human ethics committee if they felt uncomfortable with any aspect of the study.

Results

Because the analysis of RTs is only meaningful for those providing data with relatively accurate responses, 6 participants whose error rates were in excess of 20% were eliminated (all 6 were from the control condition). Individual trials with RTs in excess of 5 s (i.e., a very small number of trials were classified as univariate outliers that were greater than 7 standard deviations above the mean RT) were also removed. Finally, because nonnormative illness beliefs can manifest themselves in unique ways for each individual, the word anxiety/fear ratings were used to ensure that the illness words resulted in some level of anxiety/fear. Illness words that were given a rating of 0 (indicating no anxiety/fear) by a participant were removed from the analysis for that particular participant. Thus, participants' Stroop data were based on each individual's list of illness words that he or she deemed resulted in some degree of anxiety/fear. This resulted in the elimination of approximately 53% of the illness words overall, with an average of 21.2 ($SD = 10.7$) illness words used in the control condition and 30.9 ($SD = 11.9$) illness words used in the experimental condition.

The data were analyzed using a hierarchical regression whereby all main effects and two-way interactions were entered first into the regression equation, followed by the predicted three-way interaction. The main effects for each variable and all interactions were evaluated by examining the corresponding parameter estimate and t value. The parameter estimate (i.e., slope, b) indicates the magnitude of the effect in milliseconds. Whitley Index and SAMPI scores were standardized, and effect coding was used for the categorical variables. Illness words were coded -1 and neutral words were coded $+1$. Likewise, the control and experimental (illness-concern activation) conditions were coded -1 and $+1$, respectively.

When hypochondriacal tendencies are defined as illness preoccupation and fear (indexed by Whitley Index scores) the predicted three-way interaction does not emerge ($t = 1.12, p > .10$). Likewise, there is no significant two-way interaction between the condition and word content ($t = 0.33, p > .10$). However, a strong significant two-way interaction does emerge between the condition and Whitley Index scores ($b_{\text{Whitley} \times \text{Condition}} = 35.6, t = 5.80, p < .0001$), such that an increase by 1 standard deviation on the Whitley Index results in a 71.2-ms slower RT for those in the illness-concern induction condition relative to those in the control condition. (Because effect coding was used, RTs describing the two-way interaction are equivalent to double the parameter estimate.) A significant two-way interaction also emerges between

Whitley Index scores and word content ($b_{\text{Whitley} \times \text{Word}} = 14.9, t = 2.43, p < .05$), whereby every standard deviation increase on the Whitley Index results in the illness words being processed 29.8 ms slower than the neutral words.

When hypochondriacal tendencies are defined as a sensitivity to bodily sensations (indexed by SAMPI scores), the predicted three-way interaction does emerge ($b_{\text{SAMPI} \times \text{Word} \times \text{Condition}} = 10.6, t = 1.73, p < .05$). To better understand this interaction, we conducted a test of simple main effects by examining the SAMPI \times Word interaction for the experimental and control conditions separately. In the control condition, there was no significant interaction between SAMPI scores and word content ($t = -0.67, p > .10$). However, as predicted, a significant interaction between SAMPI scores and word content did emerge in the experimental condition ($b_{\text{SAMPI} \times \text{Word}} = 14.7, t = 1.95, p < .05$), such that every standard deviation increase on the SAMPI resulted in the illness words being processed 29.4 ms slower than the neutral words (see Figure 1).

Discussion

Our data show that in a nonclinical population, hypochondriacal tendencies, when defined as a sensitivity to bodily sensations, result in attention to task-irrelevant, illness-related stimuli, but only when illness concern has been activated. This is consistent with the recent literature examining emotionally disordered individuals (e.g., Cohen et al., 1998). However, when hypochondriasis is defined as illness preoccupation and fear, this effect does not emerge. Instead, illness preoccupation and fear results in attention to all (health- and nonhealth-related) task-irrelevant stimuli when illness concern has been activated. Together, these findings illustrate the importance of (a) the specific aspect of hypochondriacal tendencies emphasized and (b) the activation of illness concern.

It is important to note that despite the fact that we obtained the predicted three-way interaction, some aspects of our methodology may have actually suppressed the emergence of that effect. First, the semantic (schematic) relatedness within the illness word set might have exceeded that for the neutral word set, and this might have artificially decreased the RTs associated with the illness words (see Bransford, 1979). This potential problem could be controlled methodologically by using semantically related neutral words. A second issue is the randomized format for presenting words. Recent research has suggested that Stroop task interference based on word content is more likely to emerge when participants are provided with primes (Holle, Neely, & Heimberg, 1997; la Heij, Van der Heijden, & Schreuder, 1985). Thus, a randomized block design might result in a stronger effect because it would allow for semantic priming. Finally, the control words were pho-

⁴ Several different strategies could be used to handle this manipulation check. For example, it may be desirable to include only participants indicating full belief in the illness-concern manipulation (i.e., ratings of 5). However, a large number of participants would thereby be excluded, decreasing statistical power. This approach would also result in a potentially less representative sample, and it would increase the likelihood that these individuals would systematically differ from those in the control condition on other variables (e.g., gullibility). Consequently, we opted for the approach that would result in the largest and most representative sample.

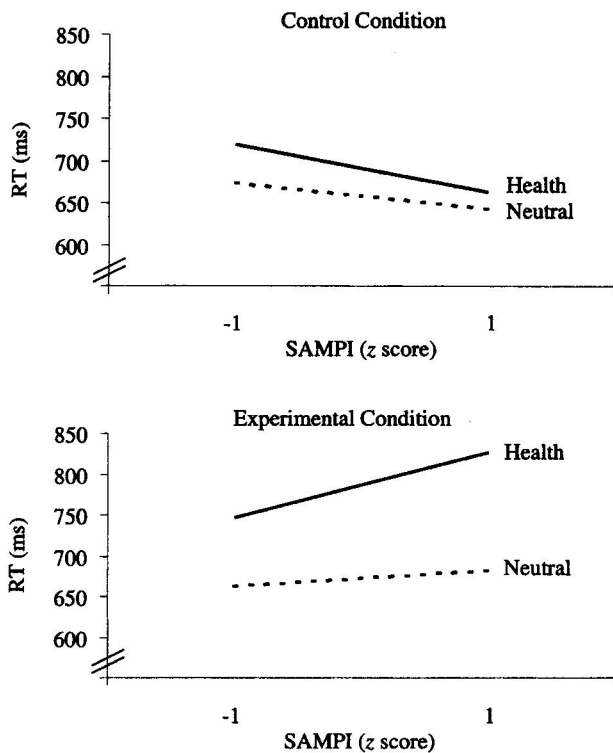


Figure 1. Decomposing the significant three-way interaction in Study 1 through a depiction of the two-way interaction effect within each condition. The experimental condition (bottom panel) involved the induction of illness concern. All predictor variables were converted to z scores, and lower order terms were included in the regression equations that generated the regression lines (see Aiken & West, 1991). RT = reaction time reported in milliseconds; SAMPI = Somatosensory Amplification Index (a measure of hypochondriacal tendencies that emphasizes sensitivity to bodily sensations); Health and Neutral = the type of stimulus words used in the Stroop task.

netically and visually similar to the illness words (e.g., *patient* vs. *patent*). This may have resulted in their functioning as illness primes for individuals hypersensitive to illness information and, presumably, to information that closely mimics illness information (la Heij et al., 1985). In an effort to strengthen our effect, we have addressed these issues in Study 2.

Several methodological concerns may limit the interpretability of Study 1. First, assignment to the two conditions was not random, and this necessarily limits our conclusions about the role of illness-concern activation. Second, although we used word ratings to ensure that the illness words resulted in some degree of anxiety/fear, we had no information on the control words, which could likewise result in an idiosyncratic activation of anxiety/fear. Finally, we did not differentiate the perceptual processes associated with state anxiety from those associated with hypochondriasis. Study 2 was designed to address each of these methodological concerns and to evaluate the robustness of the findings from Study 1.

Study 2

Study 2 replicated Study 1 with the following modifications: The neutral words were semantically related (i.e., all office-related

words) and the illness and neutral words were presented in a randomized block design. In addition, participants were randomly assigned to the conditions, state anxiety scores were assessed and statistically controlled, and we obtained anxiety/fear ratings for both illness and neutral words.

Method

Participants

In the Fall of 1998 and Spring of 1999, 187 college students were recruited from several psychology classes and randomly assigned to either a control or experimental condition. None of the participants in Study 2 had participated in Study 1. Participants were disproportionately selected for the experimental condition to offset participant loss as a consequence of the manipulation check. Initially, 85 individuals were in the control group; however, 8 participants were eliminated because of error rates in excess of 20% on the Stroop task. The resulting group of 77 control participants included 6 men and 71 women ages 18–43 ($M = 19.7$, $SD = 3.7$). The experimental condition initially included 107 participants, but 17 participants had error rates on the Stroop task in excess of 20% and were removed from the analyses. Moreover, 10 individuals who indicated that they did not believe the BP feedback during the manipulation check (ratings of 0) were also eliminated, leaving 80 participants in the experimental condition, 62 women and 18 men ranging in age from 17 to 27 ($M = 18.8$, $SD = 1.6$).

Measures

The measures used in Study 2 parallel those in Study 1 with two additions.

State Anxiety Scale. The state version of this 20-item self-report questionnaire was used to obtain current ratings of anxiety (Spielberger, Gorsuch, & Lushene, 1970). Items were rated on a 1 (*almost never*) to 4 (*almost always*) scale, and instructions emphasized how the respondent "is feeling right now."

Word anxiety/fear ratings. The 40 illness and 40 office words were rated by each participant to quantify the anxiety/fear associated with each word using a 0 (*not at all*) to 3 (*extremely*) scale.

Modified Stroop task. There were two changes to the Stroop task. First, the neutral words used were 40 semantically related nonillness words. Specifically, office words such as *desk*, *computer*, and *pencil* were used. Second, the office and illness words were presented in blocks, and block order was counterbalanced between participants. A post hoc evaluation again indicated that the illness and office words did not differ significantly in word frequency ($t = -1.21$, $p > .10$).

Procedure

The procedure remained unchanged from Study 1. The state anxiety measure and word anxiety/fear ratings for all words were added to the end of the battery of questionnaires to avoid affecting the previous measures. The office and illness words were presented in a randomized order for the anxiety/fear ratings. The SAMPI, Whitley Index, and State Anxiety Scale scores were all standardized.

Results

To address one of the potential confounds in Study 1, participants' ratings of the anxiety/fear associated with each illness and office word were assessed prior to investigating the RTs on the Stroop task. Any office words eliciting some anxiety/fear (ratings > 0) were removed. This resulted in the removal of approximately 16% of the office words overall (casewise dele-

tions), with an average of 33.9 ($SD = 7.3$) office words used in the control condition and 35.8 ($SD = 8.6$) office words used in the experimental condition. Likewise, any illness words that failed to elicit anxiety/fear (ratings = 0) were also removed. This resulted in the elimination of approximately 45% of the illness words overall, with an average of 22.4 ($SD = 12.1$) illness words used in the control condition and 22.0 ($SD = 13.2$) illness words used in the experimental condition. It is important to note that the word lists for the Stroop task for each participant included an individually constructed list of anxiety/fear-inducing illness words and office words that resulted in no anxiety/fear.⁵ As was the case in Study 1, individual trials with RTs in excess of 5 s were removed, and the predicted three-way interactions were examined before undertaking any follow-up analyses. Moreover, the effects for state anxiety were entered first into the regression equation to statistically control for this variable.

When hypochondriacal tendencies are defined as illness preoccupation and fear (indexed by the Whitely Index), the predicted three-way interaction again fails to emerge ($t = -0.96, p > .10$). Likewise, there is no significant two-way interaction between Whitely Index scores and word content ($t = 1.44, p > .10$), nor is there a significant interaction between word content and the condition ($t = -0.92, p > .10$). However, a significant two-way interaction again emerges between the condition and Whitely Index scores ($b_{\text{Whitely} \times \text{Condition}} = 15.4, t = 2.39, p < .01$), such that an increase by 1 standard deviation on the Whitely Index results in a 30.8-ms slower RT for those in the illness-concern induction condition relative to those in the control condition. (Recall that effect coding was used; therefore, RTs for the two-way interaction are equivalent to double the parameter estimate.) With regard to the covariate, there is a significant effect for state anxiety ($b_{\text{Anxiety}} = 26.1, t = 2.22, p < .05$) because every standard deviation unit increase on the State Anxiety Scale results in a 26.1-ms increase in RT.

When hypochondriacal tendencies are defined as sensitivity to bodily sensations (indexed by SAMPI scores), the predicted three-way interaction again emerges ($b_{\text{SAMPI} \times \text{Word} \times \text{Condition}} = 15.6, t = 2.95, p < .005$) despite controlling for state anxiety, which itself has a strong relation to RT (every standard deviation increase on the State Anxiety Scale results in a 32.7-ms increase in RT; $b_{\text{Anxiety}} = 32.7, t = 3.11, p < .005$). To better understand the three-way interaction, we conducted a test of simple main effects by examining the SAMPI \times Word interaction for the experimental and control conditions separately after controlling for state anxiety. In the control condition, there was no significant interaction between SAMPI scores and word content ($t = 1.39, p > .10$). However, as predicted, a significant and large interaction between SAMPI scores and word content did emerge in the experimental condition ($b_{\text{SAMPI} \times \text{Word}} = 40.6, t = 5.07, p < .0001$), such that a 1 standard deviation increase on the SAMPI results in the illness words being processed 81.2 ms slower than the neutral words (see Figure 2).

Discussion

Several noteworthy findings emerged from Study 2. First, as predicted, participants whose illness concerns were activated were more likely to show an illness-specific perseveration effect (in

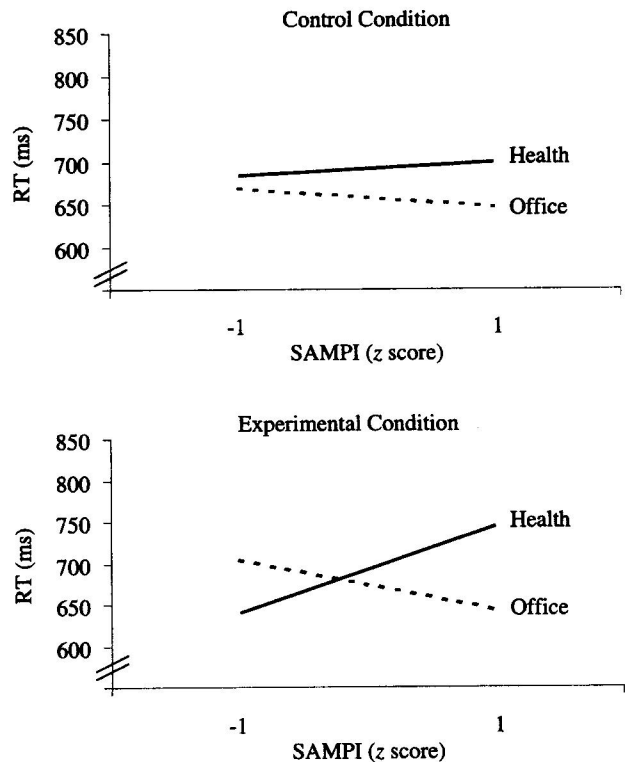


Figure 2. Decomposing the significant three-way interaction in Study 2 through a depiction of the two-way interaction effect within each condition. The experimental condition (bottom panel) involved the induction of illness concern. All predictor variables were converted to z scores, and lower order terms were included in the regression equations that generated the regression lines (see Aiken & West, 1991). RT = reaction time reported in milliseconds; SAMPI = Somatosensory Amplification Index (a measure of hypochondriacal tendencies that emphasizes sensitivity to bodily sensations); Health and Office = the type of stimulus words used in the Stroop task.

which illness words were associated with longer RTs), but only when combined with elevated SAMPI scores (i.e., a greater sensitivity to bodily sensations). Importantly, these findings were shown to be independent of state anxiety. This is crucial to differentiating the proposed activation effect for hypochondriacal tendencies from the parallel literature for anxiety disorder patients that likewise demonstrates a relation between anxiety and performance on the emotional Stroop task (e.g., Matthews & MacLeod, 1985). In addition, because the Study 2 findings were stronger than those observed in Study 1, we can assume that one or more of the three possible suppressor effects we had identified may have attenuated the effects in Study 1. The predicted three-way interaction effect consistently emerged when hypochondriacal tendencies were defined as a sensitivity to bodily sensations but not when defined as illness preoccupation and fear. Indeed, when defined as illness preoccupation and fear, individuals were shown to persevere on all task-irrelevant stimuli when illness-concern was

⁵ The number of health or neutral words removed was not related to RTs in either study.

activated (a two-way interaction). Other research has likewise found a heightened but non-health-specific perceptual sensitivity in those scoring high on illness preoccupation and fear using the Whately Index (Hanback & Revelle, 1978). This last finding indicates that one should not generalize between distinct aspects of hypochondriacal tendencies when considering perceptual functioning. Finally, the present results also appear to be relatively robust, because the same three-way interaction emerged for the SAMPI despite the changes in the stimuli, procedure, and statistical analyses.

Although the Whately Index and the SAMPI are thought to assess relatively stable characteristics, they were administered after the illness-concern induction. Thus, it is possible that the induction may have elevated these scores, in which case the relation between the self-report measures and RTs on the Stroop test might simply have reflected participant responsiveness to the induction (indicated by both self-report and RT measures). If this were the case, then participants in the experimental condition should have had higher Whately Index and SAMPI scores relative to those in the control condition. We assessed this hypothesis and found no significant differences for the Whately Index and SAMPI scores between the experimental and control conditions. In fact, in all cases, the control condition mean scores on the Whately Index and SAMPI were slightly higher than the experimental condition mean scores. Therefore, the relation between the self-report and RT measures was not artificially created by the induction.

One may also argue that the various manipulation checks (e.g., the word ratings), as well as the removal of trials on the basis of error rates, served to create the observed three-way interaction effects. This also does not appear to be a tenable conclusion. Specifically, when the analyses were rerun with all of the participants included (i.e., no participant removal due to manipulation checks or Stroop error rates) and with all of the words included (i.e., without eliminating words on the basis of the word anxiety ratings), the findings did not change. That is, the same significant three-way interaction effect for the SAMPI resulted, though the effect size was smaller. Thus, the general effect of our manipulation checks was to strengthen the effect size by minimizing noise in the data but not to create effects that were otherwise not present.

General Discussion

Researchers and clinicians have typically implicated perceptual biases in the experience of hypochondriasis (e.g., Barsky et al., 1990; Hanback & Revelle, 1978; Kirmayer et al., 1994) despite inconsistencies in the empirical evidence (e.g., Barsky et al., 1998; Brown et al., 1999; Haenen et al., 1997). The present research provides an empirical evaluation of the relation between hypochondriacal tendencies and perception under a variety of conditions. In our two independent samples, individual differences in hypochondriacal tendencies were linked to quantifiable costs in performance on the emotional Stroop task. More specifically, when illness concerns were activated, participants evidencing a sensitivity to bodily sensations directed their attention to health-related stimuli such that it slowed their performance on the color-naming task.

The mechanism that appears to be implicated is that of attention, and although perceptual processes can be interpreted in many ways, the findings suggest that hypochondriacal tendencies are, in

part, related to automated functioning (see also Kirmayer et al., 1994; Lecci, Karoly, Ruehlman, & Lanyon, 1996). This possibility is important because it provides explanations for why erroneous somatic beliefs associated with hypochondriacal tendencies can persist despite the openness of such beliefs to medical disconfirmation (cf. Leventhal & Nerenz, 1985; Skelton & Croyle, 1992; Warwick, 1989). For example, somatically focused attention can itself, without the individual's awareness or appearance of control, create or exacerbate a symptom (e.g., Pennebaker & Skelton, 1981) despite a doctor's reassurance. Moreover, heightened somatic attention, and hypochondriacal tendencies in general, may be more resistant to change simply because the mechanisms of support can exist outside of conscious awareness. Thus, perceptual biases for illness-related information as well as any resulting health behaviors (e.g., visits to doctors) and cognitions (e.g., attributing somatic experiences or symptoms to illness) may be difficult to extinguish because the person with hypochondriacal tendencies is not fully aware of these overlearned, automated processes. In the absence of these or similar explanations, it is otherwise difficult to explain the persistence of hypochondriacal beliefs that are, by definition, erroneous and result in conflictual, hostile, and frustrating doctor-patient relationships (Barsky & Klerman, 1983).

The present research also builds on the extant literature indicating that emotionally disordered individuals are prone to bias their attention toward threatening, emotionally relevant stimuli (for reviews see MacLeod & Matthews, 1991; McNally, 1990, 1994) by demonstrating that this attentional bias can likewise be observed in individuals evidencing hypochondriacal tendencies. It is important to note that our data identify the conditions under which such biases are most likely to emerge and, in so doing, offer a possible explanation for the equivocal nature of previous research. Specifically, perceptual biases emerge when hypochondriacal tendencies are operationalized and assessed as a sensitivity to bodily sensations, and only when illness concerns have been activated. Thus, inconsistencies in the literature may be due to factors such as the particular measure one uses to operationally define and assess hypochondriasis (we would have had null findings for the three-way interactions had we relied on the Whately Index alone) or the differential activation of health concern.⁶ The latter appears especially noteworthy because illness activation is a variable that is rarely experimentally controlled, yet it is likely to be an important confound because much of the research on somatoform disorders is conducted in medical settings where activation is likely to occur.

With regard to health activation, a recent finding has emerged from the depression literature that may help further explain our findings. The mood-state hypothesis posits that activation of negative mood among depressed individuals increases the likelihood of the activation and accessibility of corresponding cognitive pro-

⁶ Although we emphasize here the activation of health concern, it is also possible to construe our manipulation as a form of generalized arousal. It is interesting that recent research has suggested that patients diagnosed with somatization syndrome have elevated levels of psychophysiological arousal (Rief, Shaw, & Fichter, 1998). Thus, it is possible that mere arousal, even if not health specific, may function in the same manner as our activation of health concern.

cesses (Persons & Miranda, 1992). By extension, this suggests that in addition to the hypochondriacal *trait*, the activation of a hypochondriacal *state* at the time of assessment may be needed to access latent cognitive structures. Such a hypothesis is consistent with our data. That is, in both studies, only participants scoring high on baseline hypochondriacal tendencies (the trait) who likewise had illness concern activated (a congruent state) showed the predicted attentional bias for health-relevant stimuli. This is a particularly important issue because the hypochondriacal person's tendency to seek out medical attention by making frequent visits to doctors and health facilities may, in and of itself, serve as the means through which health concern is activated, thereby triggering the perceptual bias.

An issue that remains to be addressed is a better understanding of the process of activation. From a theoretical standpoint, Karoly (1999) has made a strong case for personal goals as the linchpin in activating and mediating other processes (including perception and attention) in the development and maintenance of psychopathology (see also Adler, 1927; Karoly, 1993; Little, 1987; Little & Chambers, 2000). Indeed, researchers have argued that goals are central to the activation and regulation of attention, functioning as perceptual guides for evaluating stimulus experiences (e.g., Klinger, Barta, & Maxeiner, 1981; Posner, 1988). In this regard, adopting numerous health-focused goals can serve as the antecedent of a heightened perceptual sensitivity for somatic cues by activating health concern (Karoly & Lecci, 1993; Lecci et al., 1996). This can occur because goals provide the framework for the establishment of specific expectations, and such expectations have been shown to increase symptom reporting and sensitivity (e.g., Schmidt et al., 1994).

One important limitation of the present research is that we rely exclusively on young, relatively healthy college students who are primarily female. Thus, our ability to extend the findings to the general population is limited. Likewise, definitive conclusions for the clinical population of hypochondriacal persons is not possible, though several clinical implications may be investigated in future research. For example, because the samples represent young, healthy individuals for whom illness concern was temporarily activated, we would expect to see a more pronounced perceptual effect when examining individuals with chronic health problems or those having longstanding and extreme hypochondriacal tendencies (e.g., adult inpatients evidencing clinical hypochondriasis) because they would have had substantially more time for their behaviors to become well rehearsed and automated (see Bargh & Chartrand, 1999). Moreover, because the perceptual effects emerged when illness concern was activated, this suggests that presumably static perceptual processes are in fact malleable. This finding foreshadows the potential utility of intervention tactics for minimizing hypochondriacal tendencies. For example, perceptual interventions could involve the use of computerized tasks that foster habituation to illness-relevant stimuli through repeated exposure (see McKenna & Sharma, 1995; Warwick & Marks, 1988). Habituation could result in making the individual less perceptually sensitive to the stimulus, or it might reduce the negative affect associated with the perceptual experience (Cioffi, 1991). It might then be easier to direct attention to other targets, thereby inhibiting attention to somatic information (e.g., Nerenz & Leventhal, 1983). Given that we have now demonstrated the role of activation in strengthening the connection between perceptual processes and

hypochondriacal tendencies, it is left to future research to examine the many clinical implications.

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