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Anthrax fears, hypochondriacal tendencies, and the effects of perceived control

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Running head: perceived control and health vulnerability

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Abstract

The present paper assesses attentional biases associated with hypochondriacal tendencies during the recent threat of bioterrorism and whether perceived control can mitigate those biases. Based on a sample of over 300 participants, hypochondriacal tendencies were shown to be associated with (1) slower reaction times on a modified emotional Stroop task when the stimulus words were anthrax related, and (2) elevated estimates of perceived risk of anthrax infection. Manipulations of perceived control over the health threat mitigated both of these effects. Specifically, individuals who had low perceived control over the health threat had greater preservation bias and greater estimated risks of anthrax infection. Our findings are consistent with the extant literature suggesting that perceived control over a health threat is central to effectively coping with that threat.

Key words: perceptual bias, hypochondriasis, perceived control, Stroop, terrorism

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Several cognitive models implicate the abnormal or pathological processing of information in the development and maintenance of psychological disorders (e.g., Clark, 1986, 1988; Foa & Kozak, 1993). Partial support for these models comes from the plethora of data showing that various forms of psychopathology can be defined, at least in part, by a unique, and typically problematic, pattern of processing perceptual stimuli (Williams, Mathews, & MacLeod, 1996). For example, research focusing on schizophrenia has consistently identified a series of deficits in attention and orientation that alter the processing of information (e.g., Hazlett, Dawson, Filion, Schell, & Nuechterlein, 1997). Likewise, panic disorder patients appear to have a specialized perceptual deficit involving a lower threshold for processing anxiety-related words as suggested by heightened physiological responding (e.g., Pauli, et al., 1997).

One common assumption in these cognitive models is that the attentional biases associated with various psychopathologies limit the attentional resources available for normal functioning (see Kahneman, 1973, and Norman & Bobrow, 1975). In a comprehensive review of the experimental literature, Mathews and MacLeod (1994) found general support for this assumption as they established that psychopathological states such as anxiety are associated with increased attention to threat cues (see also McNally, 1990, 1994). Attentional biases may therefore be destructive in two ways. First, attentional biases may perpetuate a disorder by distorting reality. For example, people with anxiety disorders may have heightened anxiety levels in part because they are biased towards perceiving anxiety-producing stimuli that those without the disorder may miss (i.e., due to a lower threshold for appraising threats; Mogg & Bradley, 1998). Second, attentional biases may inhibit the manifestation of normative behaviors by robbing the attentional system of resources required for normal functioning. Thus, identifying attentional biases and the factors that mitigate them may be critical to the treatment of these disorders (e.g., Lavy, Van-den-Hout, & Arntz, 1993). Whereas the identification of attentional biases has been well studied, relatively little research has assessed the factors that may mitigate

these biases.

The present paper assesses attentional biases associated with hypochondriacal tendencies during the recent threat of bioterrorism (i.e., anthrax exposure) and whether perceived control can mitigate those biases. Below we briefly review the research addressing the identification of attentional biases associated with hypochondriacal tendencies, the role that naturally occurring salient health threats might play in activating biases, and why perceived control may mitigate biases.

Attentional biases associated with hypochondriacal tendencies

One of the most commonly employed methodologies for documenting the presence of an attentional bias (i.e., perceptual effects) for a variety of disorders is the emotional Stroop task. In this task, subjects 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 (i.e., the time it takes subjects 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/threat related words. This effect has been found in; individuals with high trait anger (Eckhardt & Cohen, 1997), spider phobics (Lavy et al., 1993), generalized anxiety disorder patients (Mathews & MacLeod, 1985), panic disorder patients (Ehlers, Margraf, Davies, & Roth, 1988), rape victims (Foa, Feske, Murdock, Kozak, & McCarthy, 1991), combat veterans with post-traumatic stress disorder (Kaspi, McNally, & Amir, 1995), obsessive compulsive disorder patients (Foa, Ilai, McCarthy, Shoyer, & Murdock, 1993), depressed undergraduates (Gotlib & McCann, 1984), depressed outpatients (Segal, Gemar, Truchon, Guirguis, & Horowitz, 1995), and depressed inpatients (Gotlib & Cane, 1987).

Recently, Lecci and Cohen (2002) have extended the above research by using a modified emotional Stroop task to document perceptual effects for individuals evidencing hypochondriacal tendencies. The term “hypochondriacal tendencies” refers to individuals biased to viewing themselves as highly vulnerable to health threats (cf. Barsky, Cleary, Sarnie, & Klerman, 1993;

Lecci & Cohen, 2002). These individuals (described in the clinical population with the terms hypochondriasis and/or somatization) exhibit a preoccupation and fear of having an illness that persists even in the face of medical disconfirmation (Kellner, 1986; Kenyon, 1978; Warwick & Salkovskis, 1989). Despite the somatic emphasis, this experience is presumed to be largely psychological in its origin, as reflected in the descriptive label “the worried well.” Rather than avoiding negative health information, those exhibiting hypochondriacal tendencies are quick to adopt illness beliefs, and actually seek out medical information to validate their illness beliefs (Barsky & Klerman, 1983; Kellner, 1986; Warwick, 1989).

The modified emotional Stroop task employed by Lecci and Cohen (2002; hereafter referred to as the “health Stroop”) paralleled previous studies in that participants were asked to name the color of a word and response latency was recorded. However, Lecci and Cohen substituted illness related words for emotion words, and illness activation was experimentally manipulated by diagnosing a potentially dangerous symptom. Individuals randomly assigned to an illness activation condition were given a mock physical exam with the feedback that their blood pressure reading was “dangerously high.” The data, drawn from two independent samples, consistently indicated that individuals who had experienced the health threat (activation) exhibited longer reaction times (RTs) for health words, even after statistically controlling for anxiety. Moreover, this effect was dependent upon stable individual differences in hypochondriacal tendencies. That is, it was observed only in those individuals exhibiting health vulnerability beliefs as assessed by the Somatosensory Amplification Index (SAMPI; Barsky, Wyshak, & Klerman, 1990).

The findings of Lecci and Cohen (2002) extended the literature examining the perceptual effects associated with hypochondriasis by revealing the conditions under which such effects emerge. First, consistent with Persons and Miranda’s (1992) mood-state hypothesis, perceptual effects emerge only when illness fears are activated. Second, perceptual effects emerge when hypochondriacal tendencies (health vulnerability beliefs) are assessed with the SAMPI (which

measures a generalized sensitivity to bodily sensations), but not with the Whitely Index (which measures illness preoccupation and fear; Pilowsky, 1967). Finally, perceptual effects emerge even after broader anxiety ratings are statistically controlled. Thus, it appears that broader anxiety ratings can be differentiated from more specific health fears. These findings are noteworthy as they provide a rationale for the equivocal nature of previous research examining the perceptual effects for hypochondriacs (cf. Hitchcock & Mathews, 1992 and Brown, Kosslyn, Delamater, Fama, & Barsky, 1999; for a discussion, see Lecci & Cohen, 2002).

Naturally occurring health threats as catalysts

Although the existence of attentional biases in those with hypochondriacal tendencies has been documented, the situations that precipitate the onset of these biases have yet to be explored. In particular, the most prevalent activators of health concern are likely naturally occurring, salient health threats. It is therefore important to assess whether naturally occurring health threats are able to create and sustain the attentional biases that have previously emerged in laboratory settings for those evidencing hypochondriacal tendencies.

The tragic events of September 11th, 2001 provided an ecologically valid and particularly salient context within which to study the cognitive and perceptual consequences of a low probability, high consequence health threat. Specifically, shortly after September 11th, 2001, there was a spate of anthrax cases, including five deaths. The U.S. Postal service was the primary method of delivering anthrax. Because there were both examples of cross contamination and suspicions of home mailings, all individuals were at some risk to this health threat over which they have little control. Despite the low probability of contracting anthrax in the general population, the intense media coverage of the threat likely resulted in elevated risk perception (Lichtenstein, Slovic, Fishhoff, Layman, & Combs, 1978). Thus, the public's temporary elevated concern over the anthrax threat should result in perceptual biases toward anthrax related stimuli by those exhibiting hypochondriacal tendencies.

One interesting feature of the anthrax threat was the low probability of infection by the majority of the U.S. population. Therefore any health concerns activated by anthrax were necessarily the result of the mere threat of infection rather than the fear of already having contracted the virus. Whereas attentional biases associated with a confirmed illness may have health benefits (e.g., early awareness of symptom change may be critical to timely treatment), attentional biases associated with the mere threat of an illness may be detrimental, especially when the threat has a very low probability of being realized. That is, because threats associated with illnesses are pervasive, devoting attention resources to low probability threats is counterproductive. Lecci and Cohen (2002) demonstrated that attentional biases will emerge in the presence of a diagnosed health problem (i.e., elevated blood pressure). It remains uncertain whether the emergence of such biases can likewise be linked to the more prevalent situation of an as yet unrealized fear of contracting an illness.

The distinction between a diagnosed health problem and the mere threat of an illness is of central importance to differentiating the response of those exhibiting hypochondriacal tendencies from those with more normative illness beliefs. While those exhibiting hypochondriacal tendencies have a heightened sense of perceived vulnerability to health threats, the average individual generally does not feel vulnerable to health threats (e.g., Weinstein, 1984, 1987). Indeed, social cognitive research indicates that most individuals are likely to ignore information suggesting that there is a legitimate threat to their health in favor of (even less valid) information suggesting that there is no threat (Fiske & Taylor, 1991; Taylor & Brown, 1988). It is therefore likely that an illness threat will affect those exhibiting hypochondriacal tendencies to a greater degree than those exhibiting normal illness beliefs.

The mitigating effects of perceived control

Whereas identifying the situations that give rise to attentional biases is critical to understanding hypochondriasis, identifying the factors that mitigate these biases may be critical to minimizing its deleterious consequences. To identify the factors that mitigate these biases in

those exhibiting hypochondriacal tendencies, one must understand individuals' cognitive appraisals of and responses to health threats (e.g., Taylor, 1983). Research addressing this issue has been interpreted within a variety of theoretical frameworks, including the health belief model (Rosenstock, 1974), the common sense model (Leventhal, Meyer, & Nerenz, 1980), protection-motivation theory (Rogers, 1975), and the theory of reasoned action (Fishbein & Ajzen, 1975). Each of these models hypothesizes that a number of personal (individual differences) and situational (social) factors contribute to the cognitive appraisal of any health threat (see also Barsky & Klerman, 1983; Leventhal, 1986). Virtually all models of health belief formation posit that perceived vulnerability is a precursor to health preventive action (Weinstein & Sandman, 1992). For example, the health belief model (Rosenstock, 1974) suggests that perceived threats motivate individuals to take action, but beliefs about the effects of those actions determine the specific response. If perceived vulnerability is a precursor to health preventive action such as seeking medical attention, and those with hypochondriacal tendencies exhibit both excessive use of the medical system and attentional biases, it may be that perceived vulnerability is also a precursor to attentional biases. Therefore, any factor that mitigates perceived vulnerability to health threats may also mitigate the concomitant attentional biases.

Social psychological research suggests that perceptions of control over an impending threat are associated with lower risk perceptions for that threat (e.g., Friedland, 1990; Heath & Davidson, 1988). Thus, individuals having greater perceived control over a health threat should exhibit lower perceptions of risk for that same threat, which in turn, may mitigate any attentional biases towards that threat. Furthermore, the extant literature suggests that perceived control over a health threat is central to effectively coping with that threat (e.g., Thompson, 1981). From a theoretical perspective, it is assumed that health threats (or any other threatening event) should motivate the individual to make an attributional search that maximizes a sense of personal control (see also the theory of planned behavior). Thus, even self-blame can be seen as an adaptive

mechanism, when it engenders a sense of control over otherwise uncontrollable events (e.g., Janoff-Bulman & Lang-Gunn, 1986).

The consequences of perceived control have been well documented in the broader literature on health. For example, consistent with the tenets of the theory of planned behavior, researchers have demonstrated that perceived control has a strong impact on physical well-being and health status in a variety of contexts (e.g., Mahler & Kulik, 1990; McCaul, Sandgren, O'Neill, & Hinsz, 1993; Wallston, Wallston, Smith, & Dobbins, 1987), and it even predicts mortality when considering geriatric populations (e.g., Menec & Chipperfield, 1997; Rodin & Langer, 1977). Moreover, perceived control appears to mediate much of the documented health benefits of sociodemographic variables (e.g., Bailis, Segall, Mahon, Chipperfield, & Dunn, 2001; Steptoe & Appels, 1989). The specific hypothesis is that variables such as education and income provide the individual with a greater sense of perceived control, and that, in turn, influences one's ability to actively address health concerns.

Although many of the above cited studies found an association between perceived control and health related outcomes using survey research methods, it appears that experimentally manipulated control can likewise causally affect important outcomes. For example, Glass and colleagues have consistently shown that participants randomly assigned to a behavioral control condition (over aversive noise) exhibit superior performance on a subsequent task relative to individuals not having control (e.g., Glass, Reim, & Singer, 1971; Glass, Singer, & Friedman, 1969). When considering cognitive control, research also suggests that experimentally manipulated control beliefs can reduce self-reported anxiety and physiological arousal for individuals anticipating an aversive event (e.g., Holmes & Houston, 1974). Control beliefs can also mitigate the impact of an ongoing aversive event, such as pain (e.g., Girodo & Wood, 1979; Spanos, Horton, & Chaves, 1975), and they can minimize psychological distress even if control beliefs are adopted after the fact (Langer, Janis, & Wolfer, 1975). The latter research implies that perceived control is also relevant to the general stress and coping literature. For example, Lazarus

and Folkman (1984) suggest that cognitive appraisals of threat involve an initial evaluation of the stressor. This “primary appraisal” is directly affected by stable vulnerability beliefs. Lazarus and Folkman further describe a “secondary appraisal” that involves an evaluation of what can be done about the stressor. This “secondary appraisal” is directly affected by control beliefs. Thus, individual differences in perceived control, as well as variables that relate to perceived control, appear to predict health, responses to health and other related threats, as well as the consequences of various health and other related threats.

The present study

In the present study, we assessed participants’ hypochondriacal tendencies (with the SAMPI), perceptual biases (with the health Stroop task), and perceived risk of anthrax infection following the anthrax threat that occurred shortly after September 11th, 2001. In addition, we manipulated perceived control by asking half the participants’ to write down three things that were within their control that would lessen their risk of anthrax infection (the “high” control condition) and asking the remaining participants to write down three things that were outside of their control that would increase their risk of anthrax infection (“low” control condition).

The present study primarily addresses three questions. First, can we replicate the findings of Lecci and Cohen (2002) when using a naturally occurring health threat (anthrax) that is both salient and pervasive and could potentially affect the entire population? We hypothesized that hypochondriacal tendencies would predict longer reaction times (RTs) on the health Stroop, but only for anthrax-related words. Importantly, because the Stroop task does not require that participants process the meaning of the words, any delays in responding (i.e., longer RTs) are interpreted as indicating that participants are in fact attending to the word meaning.

The second question is whether experimentally manipulated control beliefs mitigate attentional biases as measured by the health Stroop task. We predicted that hypochondriacal tendencies will be related to longer reaction times for anthrax related words, but that this effect will be strongest when perceived control is low. Importantly, by manipulating control beliefs,

rather than simply assessing perceived control, we directly investigated a method that has the potential to alter the attentional biases documented in previous research. If present, the above-described finding would result in a 3-way interaction effect between word content, hypochondriacal tendencies, and level of control.

Finally, what is the relation between perceived risk, hypochondriacal tendencies, and perceived control? We assessed perceived risk to facilitate a connection to the broader literature addressing models of health belief formation. Barsky and colleagues have found that hypochondriasis is generally associated with heightened risk perceptions for health outcomes, but not for risk perceptions associated with accidents or criminal assaults (Barsky, Ahern, Bailey, Saintfort, Liu, & Peekna, 2001). However, this effect was balanced by perceptions of subjective immunity. That is, those exhibiting hypochondriacal tendencies still perceive themselves to be less vulnerable relative to risk assessments of others, but their overall level of self risk tends to be higher than that of non-hypochondriacs (Barsky et al., 2001). In a recent study, Brockway and Heath (1998) showed that perceived control directly influenced perceived risk assessments for a threatening event, with individuals in their “low control” condition evidencing elevated risk perceptions. Furthermore, low control has also been shown to result in the enactment of fewer protective acts (Heath & Davidson, 1988). We therefore predicted that risk perceptions for anthrax would be positively related to hypochondriacal tendencies and interact with perceived control. Specifically, we predicted that those in the high control condition would evidence lower perceived risk relative to those in the low control condition. Finally, based on the findings of Barsky and colleagues (2001), we predicted that the subjective immunity effect will be present.

Method

Participants

Three hundred and twenty eight participants were recruited in the Spring of 2002 from the college student population at the University of North Carolina at Wilmington. Participants

were all enrolled in one of six introductory psychology classes, and their participation was in exchange for class credit.

Measures

Health vulnerability. Individual differences in health vulnerability beliefs were assessed using the SAMPI (Barsky et al., 1990). This measure is a self-report index of sensitivity to a variety of bodily sensations using such items as ‘I am quick to sense hunger contractions in my stomach.’ The 5-item SAMPI assesses a stable pattern of functioning, as it achieved a test-retest reliability of .85 over a 28-day interval (Barsky et al., 1990). Responses are based on a five-point Likert scale, with 0 denoting "not at all" and 4 denoting "extremely". Scores can range from 0 to 20 (5 items X 4 ratings), with higher scores corresponding to greater health vulnerability. Because the SAMPI emphasizes a generalized (rather than a health-specific) sensitivity, this measure is low on face validity with regard to the construct of health vulnerability.

Self-reported risk perception. Following from the procedures employed widely in AIDS research (e.g., van der Velde, van der Pligt, & Hooykaas, 1994), individuals provided self-reported assessments of perceived risk for anthrax infection using the following question: “How do you estimate the chance that you will become infected with the anthrax virus in the next two years because of your everyday behavior?” To separate the self-vulnerability issue from a probability assessment, participants were also asked to assess the probability of anthrax infection for a similar individual using the following question: “How do you estimate the chance that a man/woman of your age, chosen at random, becomes infected with the anthrax virus in the next two years because of their everyday behavior?”

Answers to both questions required subjects to make their estimation by completing the phrase “1 in ___”. An example was also provided (i.e., If you think that there would be a 1% chance of becoming infected with anthrax, then respond with 1 in 100.”). This relative frequency response format was employed for two reasons: (1) Sedlmeier and Gigerenzer (2001) argue that people evolved to process numerical information in relative frequency format, and therefore this

format should yield responses that more accurately represent participants' intuitive estimates of amount, and (2) relative frequency format may, when compared to a probability format, more easily represent the extremely low probabilities associated with anthrax exposure.

Anthrax knowledge questionnaires. A 15-item true-false questionnaire was developed in order to evaluate participants' attention to, and retention of, the information contained in an anthrax fact sheet. The questions were piloted in a small group of subjects in order to identify items that were sufficiently difficult, such that the mean score would approximate 75% (i.e., scores on the true/false test should be greater than chance, but ceiling effects should be avoided). Five additional questions were also developed to test anthrax knowledge not contained in the fact sheet (i.e., the information would have to have been obtained outside the experimental context). Scores on the two tests were not correlated ($r = .04$, ns), and the distribution for responses to the 5-item test reflected random responding (i.e., average scores were at the 50th percentile). Moreover, scores on the 5-item test did not vary as a function of hypochondriacal tendencies. Thus, for the purpose of this study, only the 15-item anthrax knowledge test will be considered.

The perceptual task. To assess the perceptual consequences of the illness concern induction we drew from the expanding literature involving the emotional Stroop task (see Williams, Mathews, & 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 subjects 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/threat related words (e.g., Eckhardt & Cohen, 1997; Foa et al., 1991; Lecci & Cohen, 2002; Mathews & MacLeod, 1985; Segal et al., 1995).

The health Stroop task to be employed here is similar to the emotional Stroop task in that subjects are asked to name the color of a word and response latency is recorded. However, in the present study, the words to be used will be anthrax related and neutral in content. Specifically,

participants will be instructed to identify whether the color of the target word matches that of the primer word that immediately preceded it. The target words were 40 anthrax relevant (e.g., Cipro, spores, cutaneous, rash) and 40 neutral, but semantically related words (i.e., all office-related words). All of the target words were presented in one of five colors: red, purple, blue, green, and yellow. The primer words correspond to the five possible colors of the target: “red,” “purple,” “blue,” “green,” and “yellow.” All stimuli were presented on a 15” color monitor with a 60 Hz refresh rate controlled by a Pentium III microcomputer using the DOS operating system. The resolution of the monitor was 640 by 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 consists of a fixation point presented for 500 ms, followed by the name of the primer color printed in white (e.g., "blue"). The primer remains on the screen for 800 ms, followed by a 200 ms blank screen, followed by the target word (e.g., "Cipro"), whose color may or may not match that of the primer color. The participant's task is to judge whether the target word was presented in the same color as the primer color name. The target word remains on the screen until the participant presses either the “m” or “x” key on the computer keyboard to indicate their response. The key indicating a positive response was randomly chosen for each subject. Negative trials were randomly presented with a probability of .50. The anthrax and neutral words were presented using a randomized block design.

Procedure

All participants met one of six research assistants who were trained to administer the Stroop task and the various self-report measures. Individuals volunteering for the study were, upon entering the lab, given an anthrax fact sheet entitled “Facts on Anthrax” to read out loud along with photographs depicting severe cases of cutaneous anthrax exposure. The anthrax fact sheet is a summary of the information available to the public from the CNN webpage (under the link “Ten things you should know about anthrax”). The purpose of this fact sheet was threefold.

First, it helped equate individuals with regard to anthrax knowledge, as there would otherwise be some variability on this factor. Second, the fact sheet provided an activation of the health threat and related concerns. Recent research suggests that perceptual biases direct attention toward threatening, emotionally-relevant stimuli, but *only* when individuals' emotions concerning the threatening experience are activated (e.g., Cohen, Eckhardt, & Schagat, 1998; Eckhardt & Cohen, 1997; Lecci & Cohen, 2002, Persons & Miranda, 1992). Finally, the anthrax fact sheet contained all of the anthrax words that would later appear in the health Stroop task. Likewise, the neutral words all appeared on the consent form, and participants were also asked to read the consent form out loud in order to ensure that the neutral words would also be perceived. This last point is important as it ensures that all of the words (i.e., both neutral and anthrax-related) to be employed in the health Stroop task have been recently presented to all of the participants. Although an alternative approach might be to use words matched for word frequency in the English language, the complicating factor is that word frequency counts would not adequately reflect the recent increase in the occurrence of anthrax-related words. Thus, the present approach more precisely controls for word exposure and any effects it might have on RTs on the Stroop.

After reading out loud the consent form and anthrax fact sheet, participants were randomly assigned to one of two conditions in an attempt to manipulate control beliefs over the anthrax threat. In the *low control condition*, participants were asked to identify (in writing) three things that are outside of their control that should result in increasing the probability that they would contract the anthrax virus. The *high control condition* required participants to identify (in writing) three things that are within their control that should result in reducing the likelihood that they would contract the anthrax virus. Participants then completed the health Stroop task. All questionnaires, along with a final manipulation check, were completed after the health Stroop task.

For the manipulation check, participants were asked to indicate how much control they had over the likelihood that they would contract the anthrax virus using a 0 (no control) to 5 (complete control) rating scale. Participants also rated the extent to which they experienced

anxiety regarding anthrax using a 0 (no anxiety) to 5 (highest anxiety) rating scale. These two manipulation checks are intended to provide convergent and discriminant validity for the manipulation. That is, the experimental manipulation of control beliefs should result in differences on the control rating, but should not result in any differences for the anxiety rating.

Results

Perceptual consequences of anthrax fears

Because the analysis of reaction times is only meaningful for those providing data with relatively accurate responses, sixteen participants whose error rates exceeded 20% were eliminated (8 in the low control condition and 8 in the high control condition). Individual trials with RTs in excess of 4 seconds (i.e., a very small number of trials were classified as univariate outliers that were greater than 7 SDs above the mean RT) were also removed.

The data were analyzed using a hierarchical regression whereby participants' anxiety ratings from the manipulation check were entered first into the regression equation to statistically control for this variable. Furthermore, all main effects and 2-way interactions were entered into the regression equation before entering the predicted 3-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 (ms). SAMPI scores and anxiety ratings were standardized (see Aiken & West, 1991) and effect coding was used for the categorical variables. Anthrax words were coded +1 and office words were coded -1. Likewise, the low and high control conditions were coded -1 and +1, respectively.

There was no relation between anxiety ratings (the covariate) and RT ($t = 0.38, p > .10$). There was a significant effect of control, $t = 2.90, p < .01$, such that the intercept of the function predicting participants' responses in the low control condition (781 ms.) was significantly lower than that predicting participants' responses in the high control condition (797 ms). However, as

predicted, there was also a significant 3-way interaction between SAMPI scores, word content, and the control condition ($b_{\text{sampli} \times \text{word} \times \text{condition}} = -6.6, t = -2.4, p < .05$; see Figure 1).

To better understand this 3-way interaction, we conducted a test of simple main effects by examining the SAMPI by word content interaction for the high and low control conditions separately. In the high control condition, there was a significant main effect of word content ($b_{\text{word}} = 8.46, t = 2.19, p < .05$), such that participants responded an average of 16.92 ms. slower to the anthrax words than office words. There was neither a main effect of SAMPI ($t = -0.05, p > .10$) nor an interaction between SAMPI scores and word content ($t = -0.35, p > .10$). In the low control condition, there was a significant main effect of SAMPI ($b_{\text{SAMPI}} = 24.78, t = 6.25, p < .001$), such that every SD increase on the SAMPI results in 24.78 ms. slower RT. There was also a significant effect of word content ($b_{\text{word}} = 13.26, t = 3.36, p < .001$), such that participants responded 26.52 ms. slower to the anthrax words than office words. Importantly, there was a significant interaction between SAMPI scores and word content ($b_{\text{SAMPI} \times \text{word}} = 11.08, t = 3.08, p < .01$), such that every SD increase on the SAMPI results in the anthrax words being processed 22.16 ms. slower than the office words. This pattern of data indicates that the relation between hypochondriacal tendencies and perceptual biases manifested only in the low control condition.

Risk perceptions and anthrax fears

One participant's data (in addition to the 16 participants mentioned above) was eliminated for the assessment of perceived risk because it was a univariate outlier (over 10 SDs below the mean). Because participants' estimates of perceived risk were highly skewed, we transformed them by taking the log of the estimates. Two new variables were calculated to directly assess two distinct aspects of perceived risk. To assess how perceived control and hypochondriacal tendencies (SAMPI) relate to participants' absolute risk ratings, we calculated the average of each participants' self and other estimates ($[\log(\text{self}) + \log(\text{other})]/2; A_{\text{SO}}$). To assess how perceived control and hypochondriacal tendencies relate to participants' risk ratings of

themselves relative to others, we calculated the difference between participants' self and other estimates ($\log(\text{self}) - \log(\text{other})$; D_{SO}).

A_{SO} and D_{SO} were analyzed separately using a hierarchical regression whereby participants' anxiety ratings from the manipulation check were again entered first into the regression equation to statistically control for this variable. Furthermore, all main effects were entered into the regression equation before entering the predicted 2-way interaction (i.e., SAMPI X control condition). SAMPI scores and anxiety ratings were standardized and effect coding was used for the categorical variable. The low and high control conditions were coded -1 and +1, respectively.

When assessing D_{SO} , there was no effect of anxiety ratings ($t = 1.43, p > .10$). Furthermore, there were no significant main effects or interactions (all $ts < 1.5, p \geq .10$). However, when taken as a whole D_{SO} ($M = -0.60$) was significantly different from zero, indicating that participants' estimated that they had a lower risk than a similar other.

When assessing A_{SO} , there was a significant effect of anxiety ratings ($b_{\text{Anxiety}} = 0.30, t = 2.11, p < .05$). There was also a significant main effect of control ($b_{\text{Condition}} = -1.10, t = -2.14, p < .05$), such that participants in the high control condition estimated their risk as lower than those in the low control condition. The predicted two-way interaction between SAMPI and Control Condition was also significant ($b_{\text{SAMPI} \times \text{Condition}} = 0.16, t = 2.66, p < .01$; see Figure 2).

To better understand this interaction, we conducted a test of simple main effects by examining SAMPI scores for the high and low control conditions separately. In the high control condition, there was a significant effect of SAMPI ($b_{\text{SAMPI}} = 0.24, t = 2.77, p < .01$), such that participants' estimated risk of anthrax infection increased as SAMPI scores increased. In the low control condition, there were no significant effects (all $ts < 1.0, p \geq .10$). This pattern of data indicates that participants in the high control condition estimated the risk of anthrax infection as lower than that estimated by participants in the low control condition. However, the benefit of perceived control decreased as SAMPI scores increased.

Anthrax knowledge

Scores on the 15-item anthrax knowledge test did not correlate with SAMPI scores ($r = -.06$, ns), indicating that hypochondriacal tendencies do not relate to the accuracy with which health information is recalled. Based on a t -test, it was also shown that anthrax knowledge did not vary as a function of manipulated control beliefs ($t = 0.85$, $p > .10$). However, anthrax knowledge did correlate with average ratings (A_{SO}) of perceived risk for anthrax ($r = -.16$, $p < .01$), such that greater anthrax knowledge is related to lower average perceptions of risk.

Discussion

The present research provides a clear replication and extension of previous findings. Similar to Lecci and Cohen (2002), the present experiment demonstrates that, following a health threat, as hypochondriacal tendencies increase, participants exhibit longer response latencies for identifying the color of health-relevant (anthrax) words. The process that is implicated in these findings is the misallocation of attention, with longer response latencies (i.e., increased RTs) suggesting that the participants are attending to word meaning when, in fact, this interferes with the task at hand. Despite a sound theoretical rationale supporting the hypothesis that perception is implicated in the development and maintenance of illness beliefs (e.g., Cioffi, 1991; Leventhal et al., 1997), this marks only the second study to operationally define these perceptual biases in terms of a quantifiable cost to the individual, and to illustrate that the extent of the perceptual biases varies as a function of individual differences in hypochondriacal beliefs (see also Lecci & Cohen, 2002).

The mitigating effects of perceived control

An important extension of the present research was to examine the effects of perceived control on these perceptual biases. We found that by experimentally manipulating control beliefs we could mitigate the observed perceptual effects. Specifically, by giving participants a relatively simple instruction that directed their attention to potentially controllable aspects of the health-threatening stimulus, hypochondriacal tendencies no longer resulted in longer response latencies

for health (anthrax) related words relative to neutral words, even when health (anthrax) fears were activated. In other words, although the actual threat of illness did not differ between the high and low control conditions, the perceptual consequences associated with the individual's response to the threat did. Our findings are consistent with those of the extant literature, suggesting that perceived control (and similar constructs such as self-efficacy; Ajzen & Madden, 1986) is a powerful moderator in affecting individual responses to stressors (e.g., Glass et al., 1971).

It may be argued that the experimental manipulation of control activated cognitions or affective states in addition to, or instead of, perceived control, and that these effects may have impacted upon the findings. To illustrate, research suggests that behavioral control can result in less anxiety in anticipation of a stressor (e.g., Bowers, 1968; Houston, 1972; Szpiller & Epstein, 1976). This would provide an alternative account for our findings, as the control manipulation could conceivably have created anxiety in the low control condition and/or attenuated anxiety ratings in the high control condition, and this, in turn, could have resulted in less interference on the Stroop task. However, based on assessments taken immediately following the induction and the perceptual task, the two conditions were found not to differ with regard to anxiety ratings. Furthermore, after controlling for the anxiety (i.e., treating anxiety ratings as a covariate), the findings do not change. Thus, the effects of control are not related to the effects of anxiety.

Although not directly evaluated in the present study, one question that remains is why control beliefs reduce the perceptual biases associated with a hypochondriacal response to health threats. According to one of the more time-tested theories, it is possible that control beliefs simply provide the individual with the belief that they can minimize future danger (e.g., Miller, 1979). From a theoretical standpoint, behavioral control is defined, in part, by the belief that one has a behavioral response that makes a specific aversive outcome less probable (Thompson, 1981). In the present study, a similar type of behavioral control was experimentally manipulated, and control beliefs were shown to affect one's response to the anticipated aversive event.

In an attempt to more directly assess the relation between the perceived probability of an aversive outcome and perceived control, we measured our participants' perceived probability of anthrax infection for themselves and a similar other. If control beliefs provide the individual with the belief that they can minimize future danger, then our participants' perceived probability of anthrax infection should vary as a function of the control manipulation. The present study revealed two important findings. First, we replicated the research of Barsky et al. (2001) by showing that the subjective immunity effect emerges even in those exhibiting hypochondriacal tendencies. That is, participants, regardless of their hypochondriacal tendencies, estimated that they had a lower risk for anthrax exposure than a similar other. Second, and more importantly, we found that risk perceptions varied as a function of both hypochondriacal tendencies and the control manipulation. Specifically, participants' estimated risk of anthrax infection increased as their hypochondriacal tendencies increased. Moreover, participants in the high control condition estimated the risk of anthrax infection as lower than that estimated by participants in the low control condition. However, the benefit of perceived control decreased as hypochondriacal tendencies increased. Thus, although control cognitions can modify perceptions of risk, such modifications are tempered by stable, trait-like cognitions relating to health.

Overall, the data demonstrate that perceived control mitigates both the perceptual biases and risk perceptions associated with hypochondriacal tendencies. The mechanisms accounting for the effects of perceived control have been articulated extensively in several theoretical models of health belief formation. These models posit that perceived risk is a precursor to health preventive action and that risk perceptions are influenced by control beliefs (e.g., Rosenstock, 1974; Weinstein & Sandman, 1992). Our demonstrated ability to affect risk perceptions using a simple manipulation of control beliefs suggests that we might likewise affect change in health preventive actions. Indeed, our cognitive manipulation of control is consistent with the rationale that underlies most cognitive interventions in psychotherapy (e.g., Beck & Weishaar, 1989), and therefore represents a potentially powerful tool for changing human behavior. Thus, our

findings, together with those of the broader literature on perceived control (e.g., Steptoe & Appels, 1989; Thompson, 1981), suggest that perceived control has substantial and far-reaching effects on general well-being and adaptive living.

Obviously, there may be many mechanisms through which perceived control can influence perceptual biases. In the present study, we identified an automated mechanism. There may, however, also be a volitional mechanism that could eventually influence perceptual processes. Research suggests that over time, volitional processes become well rehearsed and more automated (see Bargh & Chartrand, 1999). Thus, exercising control over a volitional process may be a precursor to exerting control over more automated processing. One possible entry point for affecting change would be to consider the individual's personal goals relating to a health threat, as well as perceptions of control over these goals (Karoly & Lecci, 1993; Lecci, Karoly, Ruehlman, & Lanyon, 1996). For example, adopting health-focused goals over which one has a high degree of perceived control may serve to attenuate subsequent perceptual sensitivities for somatic cues. 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, Wolfs-Takens, Oosterlaan, & van den Hout, 1994).

Naturally occurring health threats as catalysts

The present study demonstrates that perceptual biases will manifest with a naturally occurring, highly salient health risk. This is important when considering the ecological validity of our research. In a previous laboratory-based experiment, Lecci and Cohen (2002) found that perceptual biases only emerged when participants were randomly assigned to a condition in which they were diagnosed with high blood pressure, thereby demonstrating a causal relation between the diagnosis and the perceptual biases. This was an important finding as few studies examining health vulnerability beliefs experimentally manipulate health threats so as to permit causal conclusions (see also Croyle & Ditto, 1990). However, because these effects were demonstrated in a laboratory setting, it remained unclear whether the findings would emerge if

the health threat were a naturally occurring event. The present study addressed this concern by assessing perceptual biases that manifested in response to a naturally occurring health threat (i.e., the anthrax scares present in late 2001 and early 2002). Our finding that perceptual biases associated with the anthrax threat increased with hypochondriacal tendencies demonstrates that the previously documented causal relations (Lecci & Cohen, 2002) also generalize to real life situations. An important question to consider is whether other types of naturally occurring threats would likewise serve to activate the fears and subsequent perceptual biases that have been extensively documented in anxiety states (Mathews & MacLeod, 1985; Mogg, Mathews, & Weinman, 1989) and other manifestations of psychopathology (e.g., MacLoud & Mathews, 1991; McNally, 1990).

The present study also demonstrates that perceptual biases will manifest even when the health risk is not yet realized. That is, the mere threat of an illness can produce the same perceptual biases as a diagnosed symptom (e.g., Lecci & Cohen, 2002). This finding suggests that perceptual biases may be triggered by relatively minor stimuli and may require very little time to impact the individual, provided the individual is at the higher end of the distribution for the endorsement of hypochondriacal tendencies. Given that unrealized health threats are, by definition, more prevalent than actual health threats, this suggests that perceptual biases may be readily developed. This finding is particularly intriguing in the present study because the actual risk of anthrax infection in our population was vanishingly small. The actual risk of anthrax infection can be evaluated by considering base rates for anthrax exposure in the United States (approximately 20 known cases in a population of over 280 million), and/or by considering the fact that the participants were all students at a small southeastern university that is not located near areas where anthrax was found. Thus, neither our participants' livelihood nor their geographic location would suggest a high risk of anthrax exposure.

Summary

The present findings extend the existing literature examining the self-regulation of health threatening information by interrelating two factors that have rarely been considered: (1) stable individual differences in generalized health vulnerability beliefs, and (2) perceived control over the health threat. Importantly, we have shown that after activating illness concerns in vivo, some individuals exhibit a perseveration bias for (i.e., attention to) threat-relevant stimuli. Moreover, we have again illustrated the importance of individual differences in perceived vulnerability. That is, contrary to the general tendency to ignore threat relevant information (e.g., Weinstein, 1980; Weinstein & Klein, 1996), those evidencing high perceived vulnerability will be more susceptible to the observed perseveration bias. Finally, and perhaps most importantly, perceived control appears to mitigate the above-described perseveration effect, such that it only occurs when individuals perceive their control over the health threat to be low. This is consistent with the extant literature suggesting that perceived control over a health threat is central to effectively coping with that threat (e.g., Thompson, 1981).

References

- Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Newbury Park: Sage.
- Ajzen, I., & Madden, T. J. (1986). Prediction of goal directed behavior: Attitudes, intentions and perceived behavioral control. *Journal of Experimental Social Psychology, 22*, 453-474.
- Bailis, D. S., Segall, A., Mahon, M. J., Chipperfield, J. G., & Dunn, E. M. (2001). Perceived control in relation to socioeconomic and behavioral resources for health. *Social Science and Medicine, 52*, 1661-1676.
- Bargh, J. A., Chartrand, T. L. (1999). The unbearable automaticity of being. *American Psychologist, 54*, 462-479.
- Barsky, A. J., Ahern, D. K., Bailey, E. D., Saintfort, R. L., Liu, E. B., & Peekna, H. M. (2001). Hypochondriacal patients' appraisal of health and physical risks. *American Journal of Psychiatry, 158*, 783-787.
- Barsky, A. J., Cleary, P. D., Sarnie, M. K., & Klerman, G. L. (1993). The course of transient hypochondriasis. *American Journal of Psychiatry, 140*, 273-283.
- Barsky, A. J., & Klerman, G. L. (1983). Overview: Hypochondriasis, bodily complaints, and somatic styles. *The American Journal of Psychiatry, 140*, 273-283.
- Barsky, A. J., Wyshak, G., & Klerman, G. L. (1990). The Somatosensory Amplification Scale and its relationship to hypochondriasis. *Journal of Psychiatry Research, 24*, 323-334.
- Beck, A. T., & Weishaar, M. E. (1989). Cognitive therapy. In R. J. Corsini and D. Wedding (Eds.), *Current psychotherapies* (4th Ed., pp. 285-320). Illinois: F. E. Peacock Publishers, Inc.
- Brockway, J. H., & Heath, L. (1998). Risk at night: Contextual effects of perceived control on fear of rape. *Representative Research in Social Psychology, 22*, 52-59.
- Brown, H. D., Kosslyn, S. M., Delamater, B., Fama, J., & Barsky, A. J. (1999). Perceptual and memory biases for health-related information in hypochondriacal individuals. *Journal of Psychosomatic Research, 47*, 67-78.

- Cioffi, D. (1991). Beyond attentional strategies: A cognitive-perceptual model of somatic interpretation. *Psychological Bulletin*, *109*, 25-41.
- Clark, D. M. (1986). A cognitive approach to panic. *Behaviour Research and Therapy*, *24*, 461-470.
- Clark, D. M. (1988). A cognitive model of panic attacks. In S. Rachman & J. D. Moser (Eds.), *Panic* (pp. 71-89). Hillsdale, NJ: Erlbaum.
- Cohen, D. J., Eckhardt, C. I., & Schagat, K.D. (1998). Attention allocation and habituation to anger-related stimuli during a visual search task. *Aggressive Behavior*, *24*, 399-410.
- Croyle, R. T., & Ditto, P. H. (1990). Illness cognition and behavior: An experimental approach. *Journal of Behavioral Medicine*, *13*, 31-52.
- Eckhardt, C. I., & Cohen, D. J. (1997). Attention to anger-relevant and irrelevant stimuli following naturalistic insult. *Personality and Individual Differences*, *23*, 619-629.
- Ehlers, A., Margraf, J., Davies, S., & Roth, W. T. (1988). Selective processing of threat cues in subjects with panic attacks. *Cognition and Emotion*, *2*, 201-220.
- Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention, and behavior*. Reading, MA: Addison-Wesley.
- Fiske, S., & Taylor, S. E. (1991). *Social cognition* (2nd ed.). New York: McGraw-Hill.
- Foa, E. B., Feske, U., Murdock, T. B., Kozak, M. J., & McCarthy, P. R. (1991). Processing of threat related information in rape victims. *Journal of Abnormal Psychology*, *100*, 156-162.
- Foa, E. B., Ilai, D., McCarthy, P. R., Shoyer, B., & Murdock, T. (1993). Information processing in obsessive-compulsive disorder. *Cognitive Therapy and Research*, *17*, 173-189.
- Foa, E. B., & Kozak, M. J. (1993). Pathological anxiety: The meaning and structure of fear. In N. Birbaumer & A. Ohman (Eds.), *The structure of emotion* (pp. 110-121). Seattle, WA: Hogrefe & Huber.
- Friedland, N. (1990). Attribution of control as a determinant of cooperation in exchange interactions. *Journal of Applied Social Psychology*, *20*, 303-320.

- Girodo, M., & Wood, D. (1979). Talking yourself out of pain: The importance of believing that you can. *Cognitive Therapy and Research*, 3, 23-33.
- Glass, D. C., Reim, B., & Singer, J. E. (1971). Behavioral consequences of adaptation to controllable and uncontrollable noise. *Journal of Experimental Social Psychology*, 7, 244-257.
- Glass D. C., Singer, J. E., & Friedman, L. N. (1969). Psychic costs of adaptation to an environmental stressor. *Journal of Personality and Social Psychology*, 12, 200-210.
- Gotlib, I. H., & Cane, D. B. (1987). Construct accessibility and clinical depression: A longitudinal investigation. *Journal of Abnormal Psychology*, 96, 199-204.
- Gotlib, I. H., & McCann, C. D. (1984). Construct accessibility and depression: An examination of cognitive and affective factors. *Journal of Personality and Social Psychology*, 47, 427-439.
- Hazlett, E. A., Dawson, M. E., Filion, D. L., Schell, A. M. & Nuechterlein, K. H. (1997). Autonomic orienting and allocation of processing resources in schizophrenia patients and putatively at-risk individuals. *Journal of Abnormal Psychology*, 106, 171-181.
- Heath, L., & Davidson, L. (1988). Dealing with the threat of rape: Reactance or learned helplessness? *Journal of Applied Social Psychology*, 18, 1334-1351.
- Hitchcock, P.B., & Mathews, A. M. (1992). Interpretation of bodily symptoms in hypochondriasis. *Behaviour Research and Therapy*, 30, 223-234.
- Holmes, D. S., & Houston, B. K. (1974). Effectiveness of situation redefinition and affective isolation in coping with stress. *Journal of Personality and Social Psychology*, 29, 212-218.
- Janoff-Bulman, R., & Lang-Gunn, L. (1986). Coping with disease, crime, and accidents: The role of self-blame attributions. In L. Y. Abramson (Ed.), *Social cognition and clinical psychology* (pp. 116-147). New York: Guilford.
- Kahneman, D. (1973). *Attention and effort*. Englewood Cliffs, NJ: Prentice Hall.
- Karoly, P., & Lecci, L. (1993). Hypochondriasis and somatization in college women: A personal projects analysis. *Health Psychology*, 12, 103-109.

- Kaspi, S. P., McNally, R. S., & Amir, N. (1995). Cognitive processing of emotional information in post traumatic stress disorder. *Cognitive Therapy and Research*, *19*, 433-444.
- Kellner, R. A. (1986). *Somatization and hypochondriasis*. New York: Praeger.
- Kenyon, F. E. (1978). *Hypochondria*. London: Sheldon Press.
- Langer, E. J., Janis, E. L., & Wolfer, J. A. (1975). Reduction of psychological stress in surgical patients. *Journal of Experimental Social Psychology*, *11*, 155-165.
- LavyE. H., Van den Hout, M., & Arntz, A. (1993). Attentional bias and spider phobia: Conceptual and clinical issues. *Behaviour Research and Therapy*, *31*, 17-24.
- Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*. New York: Springer.
- Lecci, L., & Cohen, D. (2002). Perceptual consequences of an illness concern induction and its relation to hypochondriacal tendencies. *Health Psychology*, *21*, 147-156.
- Lecci, L., Karoly, P., Ruehlman, L.S., & Lanyon, R.I. (1996). Goal-relevant dimensions of hypochondriacal tendencies and their relation to symptom manifestation and psychological distress. *Journal of Abnormal Psychology*, *105*, 42-52.
- Leventhal, H. (1986). Symptom reporting: A focus on process. In S. McHugh & T. M. Vallis (Eds.), *Illness behavior: A multidisciplinary model* (pp. 219-237). New York: Plenum Press.
- Leventhal, H., Benyamini, Y., Brownlee, S., Diefenbach, M., Leventhal, E. A., Patrick-Miller, L., & Robitaille, C. (1997). Illness representations: Theoretical foundations. In K. J. Petrie & J. A. Weinman (Eds.), *Perceptions of health and illness: Current research and applications*. Australia: Harwood Academic Publishers.
- Leventhal, H., Meyer, D., & Nerenz, D. (1980) The common sense representation of illness danger. In S. Rachman (Ed.) *Medical psychology* (Vol. 2, pp. 7-30). New York: Pergamon.
- Lichtenstein, S., Slovic, P., Fischhoff, B. Layman, M., & Combs, B. (1978). Judged frequency of lethal events. *Journal of Experimental Psychology: Human Learning and Memory*, *4*, 551-578.
- MacLeod, C. M., & Mathews, A. M. (1991). Cognitive-experimental approaches to the emotional

- disorders. In P. R. Martin (Ed.), *Handbook of behavior therapy and psychological science: An integrative approach* (pp. 116-150). Elmsford, NY: Pergamon.
- Mahler, H. I., & Kulik, J. A. (1990). Preferences for health care involvement, perceived control and surgical recovery: A prospective study. *Social Science and Medicine*, *31*, 743-751.
- Mathews, A. M., & MacLeod, C. (1985). Selective processing of threat cues in anxiety states. *Behaviour Research and Therapy*, *23*, 563-569.
- Mathews, A. M., & MacLeod, C. (1994). Cognitive approaches to emotion and emotional disorders. *Annual Review of Psychology*, *45*, 25-50.
- Menec, V. H., & Chipperfield, J. G. (1997). The interactive effect of perceived control and functional status on health and mortality among young-old and old-old adults. *Journals of Gerontology*, *52B*, 118-126.
- McCaul, K. D., Sandgren, A. K., O'Neill, H. K., & Hinsz, V. B. (1993). The value of the theory of planned behavior, perceived control, and self-efficacy for predicting health-protective behaviors. *Basic and Applied Social Psychology*, *14*, 231-252
- McNally, R. J. (1990). Psychological approaches to panic disorder: A review. *Psychological Bulletin*, *108*, 403-419.
- McNally, R. J. (1994). *Panic disorder*. New York: Guilford Press.
- Mogg, K., & Bradley, B. P. (1998). A cognitive-motivational analysis of anxiety. *Behaviour Research and Therapy*, *36*, 809-848.
- Mogg, K., Mathews, A., & Weinman, J. (1989). Selective processing of threat cues in anxiety states: A replication. *Behaviour Research and Therapy*, *27*, 317-323.
- Miller, S. M. (1979). Controllability and human stress: Method, evidence and theory. *Behaviour Research and Therapy*, *17*, 287-304.
- Norman, D. A., & Bobrow, D. J. (1975). On data-limited and resource-limited processing. *Cognitive Psychology*, *7*, 44-64.
- Pauli, P., Dengler, W., Wiedemann, G., Montoya, P., Flor, H., Birbaumer, N., & Buchkremer, G.

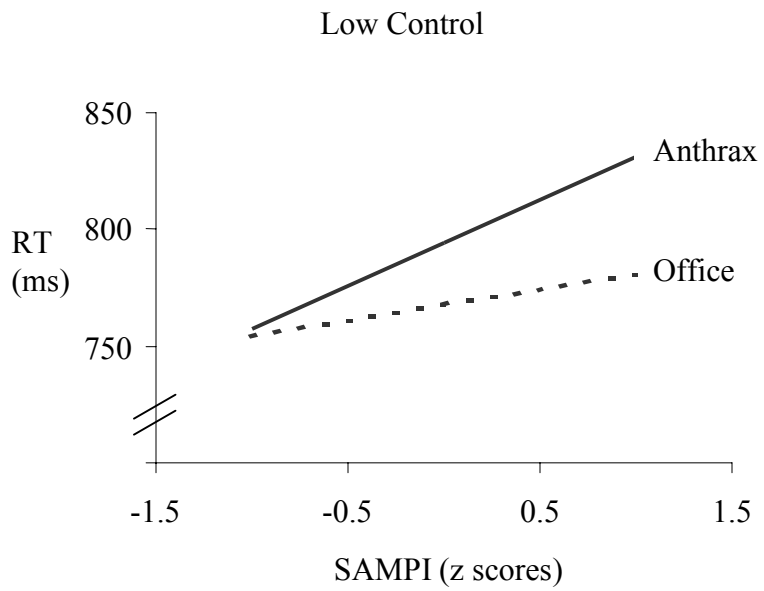
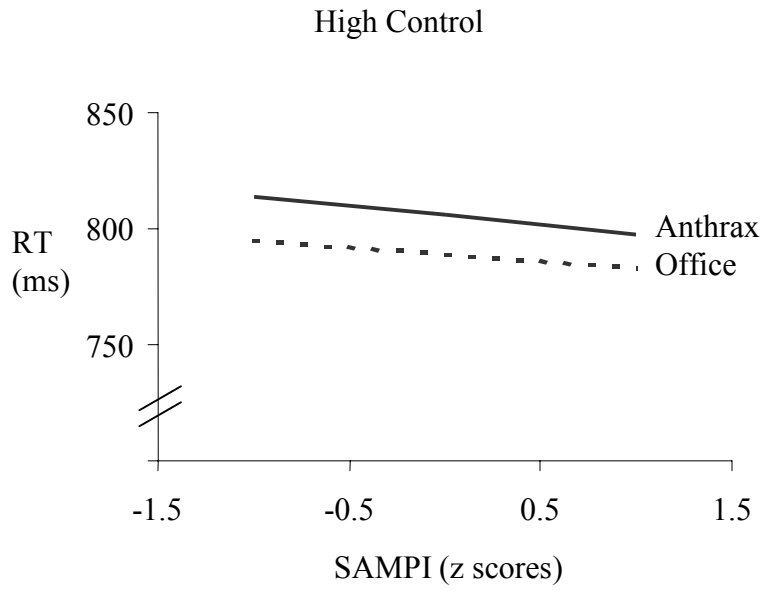
- (1997). Behavioral and neurophysiological evidence for altered processing of anxiety-related words in panic disorder. *Journal of Abnormal Psychology, 106*, 213-220.
- Persons, J. B., & Miranda, J. (1992). Cognitive theories of vulnerability to depression: Reconciling negative evidence. *Cognitive Therapy and Research, 16*, 485-502.
- Pilowsky, I. (1967). Dimensions of hypochondriasis. *British Journal of Psychiatry, 113*, 89-93.
- Rodin, J., & Langer, E. J. (1977). Long-term effects of a control-relevant intervention with the institutionalized aged. *Journal of Personality and Social Psychology, 35*, 897-902.
- Rogers, R. W. (1975). A protection motivation theory of fear appeals and attitude change. *Journal of Social Psychology, 102*, 79-91.
- Rosenstock, I. M. (1974). Historical origins of the health belief model. *Health Education Monographs, 2*, 328-335.
- Schmidt, A. J. M., Wolfs-Takens, D. J., Oosterlaan, J., & van den Hout, M. A. (1994). Psychological mechanisms in hypochondriasis: Attention-induced physical symptoms without sensory stimulation. *Psychotherapy and Psychosomatics, 61*, 117-120.
- Sedlmeier, P., & Gigerenzer, G. (2001). Teaching Bayesian reasoning in less than two hours. *Journal of Experimental Psychology: General, 130*, 380-400.
- Segal, Z. V., Gemar, M., Truchon, C., Guirguis, M., & Horowitz, L. M. (1995). A priming methodology for studying self-representation in major depressive disorder. *Journal of Abnormal Psychology, 104*, 205-213.
- Spanos, N. P., Horton, C., & Chaves, J. F. (1975). The effects of two cognitive strategies on pain threshold. *Journal of Abnormal Psychology, 84*, 677-681.
- Stephens, A., & Appels, A. (Eds.). (1989). *Stress, personal control and health*. Oxford, England: John Wiley and Sons.
- Taylor, S. E. (1983). Adjustment to threatening events: A theory of cognitive adaptation. *American Psychologist, 38*, 1161-1173.
- Taylor, S. E., & Brown, J. D. (1988). Illusion and well being: A social psychological perspective

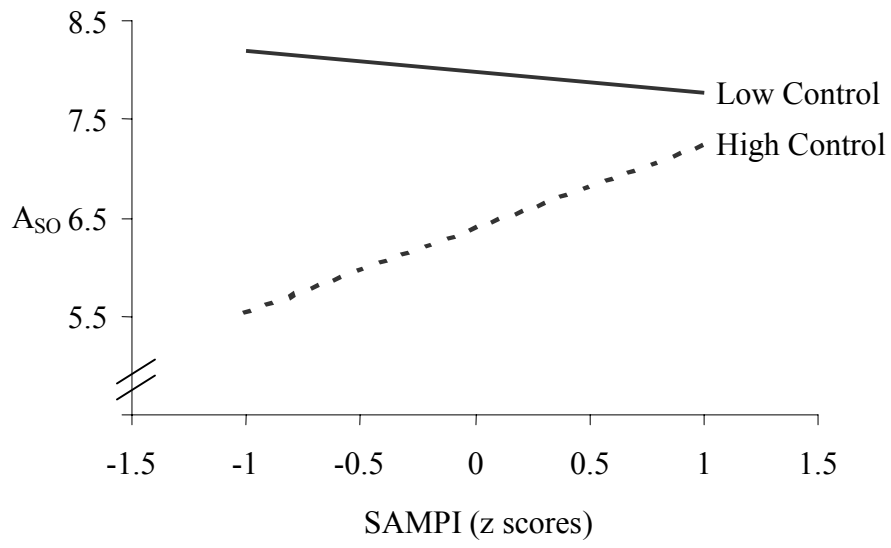
- on mental health. *Psychological Bulletin*, *103*, 193-210.
- Thompson, S. C. (1981). Will it hurt less if I can control it? A complex answer to a simple question. *Psychological Bulletin*, *90*, 89-101.
- van der Velde, F. W., van der Pligt, J., & Hooykaas, C. (1994). Perceiving AIDS-related risk: Accuracy as a function of differences in actual risk. *Health Psychology*, *13*, 25-33.
- Wallston, K. A., Wallston, B. S., Smith, S., & Dobbins, C. J. (1989). Perceived control and health. In M. Johnston & T. Marteau, (Eds), *Applications in health psychology* (pp. 5-25). New Brunswick, NJ: Transaction Publishers.
- Warwick, H. M. (1989). A cognitive-behavioral approach to hypochondriasis and health anxiety. *Journal of Psychosomatic Research*, *33*, 705-711.
- Warwick, H. M., & Salkovskis, P. M. (1989). Cognitive and behavioral characteristics of primary hypochondriasis. *Scandinavian Journal of Behavior Therapy*, *18*, 85-92.
- Weinstein, N.D. (1984). Why it won't happen to me: Perceptions of risk factors and susceptibility. *Health Psychology*, *3*, 431-457.
- Weinstein, N.D. (1987). Unrealistic optimism about susceptibility to health problems: Conclusions from a community-wide sample. *Journal of Behavioral Medicine*, *10*, 481-500.
- Weinstein, N. D. (1980). Unrealistic optimism about future life events. *Journal of Personality and Social Psychology*, *39*, 806-820.
- Weinstein, N. D., & Klein, W. M. (1996). Special issue: Unrealistic optimism about personal risk. *Journal of Social and Clinical Psychology*, *15*, 1-142.
- Weinstein, N. D., & Sandman, P. M. (1992). A model of the precaution adoption process: Evidence from home radon testing. *Health Psychology*, *11*, 170-180.
- Williams, J.M.G., Mathews, A. M., & MacLeod, C. (1996). The emotional Stroop task and psychopathology. *Psychological Bulletin*, *120*, 3-24.

Figure Captions

Figure 1. Decomposing the significant 3-way interaction through a depiction of the 2-way interaction effect within each experimental condition. The experimental condition involved the manipulation of perceived control. 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 = Reactions time reported in milliseconds. SAMPI = A measure of hypochondriacal tendencies that emphasizes sensitivity to bodily sensations. Office and Anthrax = the type of stimulus words used in the Stroop task.

Figure 2. Depicting the significant 2-way interaction between SAMPI scores and the experimental manipulation of perceived control. 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). A_{SO} = the average of each participants' self and other estimates ($[\log(\text{self}) + \log(\text{other})]/2$). SAMPI = A measure of hypochondriacal tendencies that emphasizes sensitivity to bodily sensations.





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Thompson, S. C., & Wierson, M. (2000). Enhancing perceived control in psychotherapy. In C. R. Snyder and R. E. Ingram (Eds.), *Handbook of psychological change: Psychotherapy processes and practices for the 21st Century* (pp. 177-197). New York: John Wiley & Sons.