

## BRIEF REPORT

### **Altered processing of health threat words as a function of hypochondriacal tendencies and experimentally manipulated control beliefs**

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Attentional biases associated with various forms of psychopathology have been well documented. Few studies, however, have assessed the factors that moderate these biases. The present paper assesses the biased processing of health words as a function of hypochondriacal tendencies during a threat of bioterrorism (anthrax), and whether perceived control can moderate those biases. Based on a sample of 328 participants, hypochondriacal tendencies were associated with slower reaction times on a modified emotional Stroop task when the stimulus words were anthrax-related, and this effect was moderated by a manipulation of perceived control. Specifically, individuals with low perceived control over the health threat had greater attentional bias of anthrax infection, independent of related variables such as anxiety.

Several cognitive models implicate the abnormal or pathological processing of information in the development and maintenance of psychological

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disorders (e.g., Clark, 1988; Foa & Kozak, 1993). Partial support for these models comes from the 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). One common assumption in these cognitive models is that the processing of perceptual stimuli is affected by some form of attentional bias (for reviews see Mathews & MacLeod, 1994; McNally, 1990).

Attentional biases may contribute to psychopathological states in two ways. First, attentional biases may perpetuate a disorder by distorting reality and making the detection of anxiety-producing stimuli more likely due to a lower threshold for appraising threats (Mogg & Bradley, 1998). Second, attentional biases may inhibit the manifestation of normative behaviours by robbing the attentional system of resources required for normal functioning (Kahneman, 1973; Norman & Bobrow, 1975). Thus, identifying attentional biases and the factors that affect them may be critical to the treatment of these disorders (e.g., Lavy, Van den Hout, & Arntz, 1993).

One of the most commonly employed methodologies for documenting the presence of an attentional bias 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 colour of both affectively and nonaffectively valenced words, with response latency functioning as the dependent variable. The accumulated data indicate that, relative to control participants, emotionally-disordered participants demonstrate longer colour naming latencies to emotion/threat-related words (e.g., Eckhardt & Cohen, 1997; Lavy et al., 1993; Mathews & MacLeod, 1985).

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 (Barsky, Cleary, Sarnie, & Klerman, 1993; Lecci & Cohen, 2002). These individuals exhibit a preoccupation and fear of having an illness that persists even in the face of medical disconfirmation (e.g., Kellner, 1986; Warwick, 1989). Despite the somatic emphasis, this experience is presumed to be largely psychological in its origin. Unlike the average person who avoids negative health information (Taylor & Brown, 1988) and has a presumption of invulnerability to illness (e.g., Weinstein, 1984), those exhibiting hypochondriacal tendencies are quick to adopt illness beliefs and seek out medical information to validate their illness beliefs (Barsky & Klerman, 1983; Kellner, 1986; Warwick, 1989). One mechanism thought to undergird hypochondriasis is somatic amplification, which involves experiencing bodily sensations as noxious due to sensory, perceptual or cognitive distortions (e.g., Barsky & Klerman, 1983).

The modified emotional Stroop task employed by Lecci and Cohen (2002; referred to as the *health Stroop*) substituted illness-related words for emotion

words. Lecci and Cohen experimentally manipulated illness activation using a mock physical exam with false feedback regarding the participants' blood pressure. The findings from two independent samples illustrated a positive relation between reaction times and hypochondriacal tendencies, but only for illness words and only in those whose illness fears were activated (Lecci & Cohen, 2002).

Whereas identifying the situations that give rise to attentional biases is critical to understanding hypochondriasis and other forms of psychopathology, identifying the factors that affect these biases may be critical to minimising their deleterious consequences. Social psychological research suggests that perceptions of control over an impending threat are associated with reduced perceived vulnerability (e.g., Friedland, 1990; Heath & Davidson, 1988). Lazarus and Folkman (1984) suggested that cognitive appraisals of threat involve an initial evaluation of the stressor. This "primary appraisal" is directly affected by stable vulnerability beliefs (e.g., hypochondriacal tendencies). Lazarus and Folkman further described a "secondary appraisal" that involves an evaluation of whether something can be done about the stressor (i.e., an attributional search; see also the theory of planned behaviour). This appraisal is directly affected by control beliefs, along with related beliefs involving predictability. Thus, perceived control over a threat is central to coping effectively with that threat (see also Thompson, 1981), even when control beliefs are adopted after the fact (e.g., Langer, Janis, & Wolfer, 1975). More relevant to the present study, the consequences of perceived control have been documented in the literature on health (e.g., Menec & Chipperfield, 1997; Rodin & Langer, 1977). Thus, individuals with greater perceived control over a health threat should exhibit lower perceptions of vulnerability, which in turn may minimise any attentional biases towards that threat.

## THE PRESENT STUDY

The present paper assesses attentional biases associated with hypochondriacal tendencies during a threat of bioterrorism (anthrax exposure), and whether perceived control can moderate those biases. Participants' hypochondriacal tendencies were defined as a generalised sensitivity to bodily sensations, perceptual biases were assessed with the health Stroop task, and health fears were experienced as a function of the anthrax threat that occurred shortly after 11 September 2001. Despite the low probability of contracting anthrax in the general population, the intense media coverage of the threat likely resulted in elevated risk perceptions (Lichtenstein, Slovic, Fishhoff, Layman, & Combs, 1978). Thus, it was hypothesised that the public's temporarily elevated concern over the anthrax threat would result in

perceptual biases toward anthrax-related stimuli, particularly for those exhibiting higher hypochondriacal tendencies.

Perceived control was experimentally manipulated by asking half of the participants to write down three things that were within their control that would affect their risk of anthrax infection (“high” control condition) while the remaining participants wrote down three things that were outside of their control that would affect their risk of anthrax infection (“low” control condition). Although the literature suggests that control, or an increase in the experience of control over a threat, can influence colour-naming latencies on the Stroop, the exact nature of this association has not been consistent nor has a word (content) specific effect consistently emerged (cf., Glass, Singer, Leonard, Krantz, Cohen, & Cummings, 1973; Zvolensky, Eifert, Lejuez, & McNeil, 1999). In the present study, it was predicted that hypochondriacal tendencies would be related to longer reaction times for anthrax-related words, and this effect would only emerge when perceived control is low (i.e., a 3-way interaction effect between word content, individual differences in hypochondriacal tendencies, and level of control).

## METHOD

### Participants

Three hundred twenty-eight college students (68% female) aged 18 to 23 ( $M = 18.9$ ,  $SD = 1.1$ ) were recruited in the Spring of 2002 from a mid-sized south-eastern university. They were enrolled in one of six psychology classes, and participated in exchange for class credit. Half of the participants (164) were randomly assigned to a high-control condition and the remaining participants (164) were assigned to a low-control condition.

### Measures

*Hypochondriacal tendencies.* The SAMPI is a self-report index that assesses the tendency to amplify benign bodily sensation (Barsky, Wyshak, & Klerman, 1990). This 5-item instrument is highly correlated with several measures of hypochondriasis and it assesses a stable pattern of functioning, with test–retest reliabilities of .85 over a 28-day interval (Barsky et al., 1990). Responses are on a 5-point Likert scale (ranging from 0 = *not at all* to 4 = *extremely*). Because the SAMPI emphasises a generalised sensitivity (e.g., “I am quick to sense the hunger contractions in my stomach”), this measure is low in face validity with regard to hypochondriacal tendencies (Lecci, 2004).

*Positive Affect/Negative Affect Scales (PANAS).* This widely-used measure requires one to indicate the extent to which 20 affective states (e.g., “excited”, “upset”, etc.) are experienced “in general” using a 5-point

scale (ranging from 1 = *very little/not at all* to 5 = *extremely*). The 8-week test-retest reliability for this instruction set is .70 (Watson, Clark, & Tellegen, 1988).

*Diagnostic checklist.* Participants were asked to indicate if they had ever been *diagnosed by a doctor* as having any one of eleven common chronic illness categories, such as cancer, heart disease, and "other" (see Lecci, Karoly, Ruehlman, & Lanyon, 1996). The importance of emphasising a doctor's diagnosis is that confounds with hypochondriasis are minimised, as hypochondriacs might be more prone to *think* that they have a diagnosis. A total diagnosis score is equal to the sum of all items endorsed.

*Anthrax knowledge questionnaire.* A 15-item true/false questionnaire was derived directly from the anthrax fact sheet to evaluate participants' knowledge of anthrax (see Procedure below). The questionnaire's internal reliability (Cronbach's alpha) was .71.

*The perceptual task.* The health Stroop task employed here is consistent with the procedures from previous research, the exception being the specific words used in the task (e.g., Eckhardt, & Cohen, 1997; Lecci & Cohen, 2002). Participants are required to identify whether the colour of a target word matches that of a primer word that immediately preceded it. The target words were 40 anthrax-relevant (e.g., Cipro, spores, cutaneous, Daschle, Leahy, envelope) and 40 neutral, but semantically-related, words (i.e., all office-related words). All of the target words were presented in one of five colours: red, purple, blue, green, and yellow. The primer words correspond to the five possible colours of the target: "red", "purple", "blue", "green", and "yellow". All stimuli were presented on a 15-inch colour monitor controlled by a Pentium III microcomputer using the DOS operating system.

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 colour 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., "Cipro"), the colour of which may or may not have matched that of the primer colour. The task was to judge whether the target word was presented in the same colour as the primer colour name. The target word remained on the screen until the participant pressed either the "m" or "x" key on the computer keyboard. The key indicating a positive response was randomly chosen for each subject. Matching and non-matching trials were randomly presented with a probability of .50.

Recent research suggests that Stroop-task interference based on word content is more likely to emerge when participants are provided with primes (e.g., Ia-Heij, Van-der-Heijden, & Schreuder, 1985). Therefore: (1) anthrax

and neutral words were presented using a randomised block design; and (2) the neutral words were semantically related. These two controls were instituted to avoid the situation in which the semantic (schematic) relatedness within the illness word set might exceed that for the neutral word set, thereby artificially decreasing the reaction times (RTs) associated with the illness words (see Bransford, 1979). Furthermore, the anthrax and neutral words did not differ with regard to the average number of syllables in each word. Finally, the anthrax and neutral words were matched for recent exposure because word frequency data would not be sufficiently up to date to account for the short-term increase in frequency for anthrax-related words (word frequency data only works for words where frequency is stable over time). Exposure was controlled by: (1) embedding all the words used in the current Stroop task in the anthrax information and consent forms; and (2) having participants read out loud the consent and anthrax forms before engaging in the Stroop.

The Stroop methodology used in the present experiment differs from that of more traditional emotional Stroop tasks (e.g., single word presentation, push-button response, blocked design, etc.; MacLeod, 1991). Nevertheless, it is consistent with many of the modified Stroop tasks presented in the cognitive literature (Melara & Algom, 2003). Of greater significance, however, is the fact that the current Stroop methodology is consistent with the methods employed in recently published emotional and health Stroop research (e.g., Lecci & Cohen, 2002), and yields findings that are in agreement with the extant emotional Stroop literature, such that psychopathological states are associated with increased attention to threat cues (e.g., McNally, 1990).

## Procedure

All participants met one of six research assistants who were trained to administer the Stroop task and the various self-report measures. Participants were first given an anthrax fact sheet entitled "Facts on Anthrax" to read out loud along with photographs depicting cases of cutaneous anthrax exposure. The anthrax fact sheet is a summary of the information that was available to the public from the CNN webpage (under the link "Ten things you should know about anthrax": <http://edition.cnn.com/2001/HEALTH/conditions/10/12/anthrax.qanda/index.html>). The purpose of this fact sheet was to: (1) equate individuals with regard to anthrax knowledge; (2) provide an activation of the health threat and related concerns (research suggests that activation is necessary to produce attentional biases; e.g., Cohen, Eckhardt, & Schagat, 1998; Eckhardt & Cohen, 1997; Lecci & Cohen, 2002, Persons & Miranda, 1992); and (3) provide recent exposure for the anthrax

words that would later appear in the health Stroop task (the same is true for the neutral words, which all appeared on the consent form). 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. Thus, the present approach controls for word exposure and any effects it might have on RTs on the Stroop.

After reading the consent form and anthrax fact sheet out loud, participants were randomly assigned to one of two conditions in order to manipulate control beliefs over the anthrax threat. In the *low-control condition*, participants were asked to identify (in writing) three things outside of their control that should result in increasing the probability that they would contract the anthrax virus. Example statements that were generated in the low-control condition included: "Receiving a tainted package in the mail", "Exposure to anthrax spores in the air", and "Being bitten by an infected insect". The *high-control condition* required participants to identify (in writing) three things within their control that should result in reducing the likelihood that they would contract the anthrax virus. Example statements that were generated in the high-control condition included: "Wearing gloves when opening the mail", "Not handling any unfamiliar/suspicious mail", and "Taking Cipro". 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 6-point rating scale (ranging from 0 = *no control* to 5 = *complete control*). Participants also rated the extent to which they experienced anxiety regarding anthrax using a 6-point rating scale (ranging from 0 = *no anxiety* to 5 = *highest anxiety*).

## RESULTS

The data from 16 participants (8 from each condition) were removed because their error rates exceeded 20%, and trials with RTs in excess of 4 seconds (these rare univariate outliers were greater than 7 *SDs* above the mean RT) were also removed. Analyses were conducted on the correct RT data of 156 participants in the low-control condition and 156 in the high-control condition. (When the data are transformed into normality and outliers removed, the pattern of the data is unchanged. Also, when the data are analysed separately for matched and unmatched trials, the findings do not change.)

To first determine if the experimental manipulation of control was successful, a simple *t*-test was employed using the manipulation check ratings. The results indicate that following the manipulation the low-control

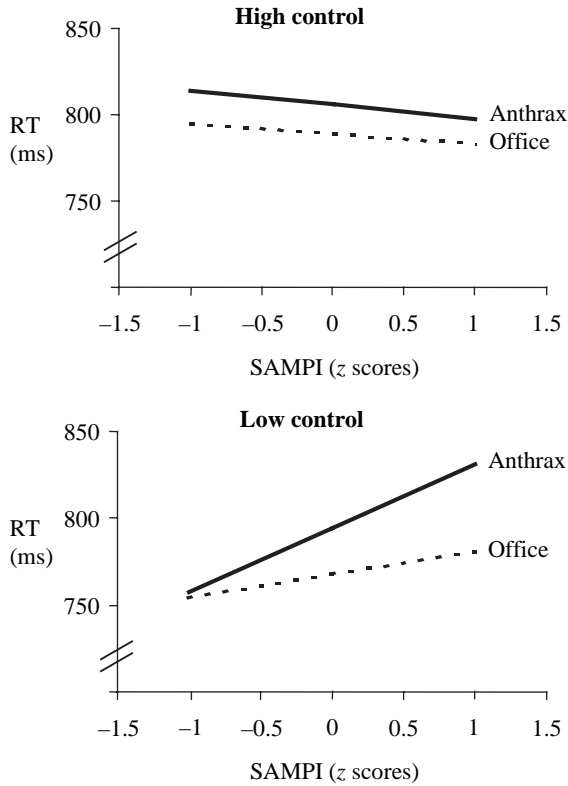
condition ( $M=1.76$ ,  $SD=1.2$ ) yielded perceived control ratings that were significantly lower than the high-control condition ( $M=3.02$ ,  $SD=1.1$ );  $t=8.97$ ,  $p<.0001$ . Moreover, anxiety ratings taken at the same time illustrate the specificity of the manipulation, as the high- ( $M=1.70$ ,  $SD=1.3$ ) and low- ( $M=1.74$ ,  $SD=1.2$ ) control conditions did not differ with regard to self-reported anxiety ( $t=0.21$ ,  $p>.1$ ).

To rule out the possible confounding role of other variables that could be influenced by control perceptions and that could likewise affect performance on the health Stroop, the two conditions were compared with regard to their scores on the PANAS, the anthrax knowledge questionnaire, and the self-report diagnostic checklist. The two conditions were found not to differ with regard to positive affect (high control:  $M=14.9$ ,  $SD=5.2$ ; low control:  $M=15.3$ ,  $SD=5.2$ ;  $t=0.66$ ,  $p>.1$ ), negative affect (high control:  $M=7.0$ ,  $SD=6.0$ ; low control:  $M=7.5$ ,  $SD=6.6$ ;  $t=0.64$ ,  $p>.1$ ), scores on the diagnostic checklist (high control:  $M=0.24$ ,  $SD=0.54$ ; low control:  $M=0.37$ ,  $SD=1.2$ ;  $t=1.17$ ,  $p>.1$ ), and anthrax knowledge (high control:  $M=11.1$ ,  $SD=2.2$ ; low control:  $M=11.3$ ,  $SD=2.2$ ;  $t=0.85$ ,  $p>.1$ ). This indicates that the random assignment procedure was effective and that the manipulation of control beliefs did not alter perceptions of anthrax knowledge, anxiety, overall health or affect.

For the primary hypotheses to be tested, the data were analysed using a hierarchical regression, whereby participants' anxiety ratings from the manipulation check were entered first into the regression equation to statistically control for generalised (as opposed to health-specific) anxiety. All main effects and 2-way interactions were entered into the regression equation before testing the predicted 3-way interaction. The main effect for each variable and all interactions were evaluated by examining the corresponding parameter estimate and  $t$ -value. The unstandardised regression coefficient (i.e.,  $B$ ) indicates the magnitude of the effect in milliseconds (ms). SAMPI scores and anxiety ratings were standardised (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 high- and low-control conditions were coded +1 and -1, respectively.

There was no relation between generalised anxiety ratings (the covariate) and RT ( $t=0.38$ ,  $p>.1$ ). 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). As predicted, there was a significant 3-way interaction between hypochondriacal tendencies, word content, and the control condition ( $B_{\text{SAMPI} \times \text{word} \times \text{condition}} = -6.6$ ,  $t = -2.4$ ,  $p < .05$ ; see Figure 1).

To better understand this 3-way interaction, a test of simple main effects was conducted by separately examining the SAMPI by word content



**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 emphasises sensitivity to bodily sensations. Office and Anthrax =the type of stimulus words used in the Stroop task.

interaction for the high- and low-control conditions. 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 17 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 25 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 27 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 ms slower than the office words. Thus, someone scoring 2  $SD$ s above the mean on hypochondriacal tendencies (SAMPI) will exhibit a main effect for word content of approximately 44 ms, and this effect size is comparable to that observed in the emotional Stroop literature (e.g., Matthews & Harley, 1996).

## DISCUSSION

The present experiment demonstrates that, following a health threat, as hypochondriacal tendencies increase, participants exhibit longer response latencies for identifying the colour 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 (see Mathews & MacLeod, 1994). Despite a sound theoretical rationale supporting the hypothesis that perception is implicated in the development and maintenance of illness beliefs (e.g., Cioffi, 1991), this represents one of only a small number of studies to show that perceptual biases vary as a function of hypochondriacal tendencies (see also Hanback & Revelle, 1978; Hitchcock & Matthews, 1992; Lecci & Cohen, 2002).

Previous research had illustrated that perceptual biases will emerge in response to a documented health problem (Lecci & Cohen, 2002). The present study further demonstrates that perceptual biases will manifest even when the health risk is not yet realised. That is, the mere threat of an illness can produce the same perceptual biases as a diagnosed symptom. Given that unrealised 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 because the actual risk of anthrax infection in our population was so small (i.e., neither our participants' livelihood nor their geographic location would suggest a "high" risk of anthrax exposure).

### The moderating effects of perceived control

A central finding of the present research is that perceived control moderates the effect of hypochondriacal tendencies. 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 anthrax-related words relative

to neutral words, even when anthrax fears were activated. Although the actual threat of anthrax did not differ between the high- and low-control conditions, the perceptual consequences associated with the individual's response to the threat did. The interaction between hypochondriacal tendencies and perceived control parallels the theoretical link between primary and secondary threat appraisals, and is consistent with the general stress and coping literature (e.g., Lazarus & Folkman, 1984).

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. Because the control manipulation necessarily implicates the predictability of the health threat, event predictability may be the reason for the reduced effect in the high-control condition (e.g., Averill, 1973). However, according to one of the more time-tested theories, control beliefs allow the individual to conclude that future danger can be minimised (e.g., Miller, 1979). Theoretically, behavioural control is defined, in part, by the belief that one has a behavioural response that makes a specific aversive outcome less probable (Thompson, 1981). In the present study, a similar type of behavioural control was experimentally manipulated, and control beliefs were shown to affect one's response to the aversive event.

An alternative explanation for the effects of control emerges when the results of the present data are compared to the findings from an earlier study in which there was an experimental manipulation of illness activation prior to the health Stroop task (Lecci & Cohen, 2002). Specifically, the results from the low-control condition in the present study appear to mimic the pattern of data observed in the illness-activation condition of the previous research. Because the present investigation involved an activation of illness (anthrax) threat in both conditions, it is therefore possible that giving participants a sense of high control minimises illness activation (cf. Thompson & Wierson, 2000). If correct, this would be an especially powerful use of the control manipulation, though further experimentation would be needed to validate this hypothesis.

### Limitations and future directions

Perceived control is a complex construct that implicates numerous psychological variables. Consequently, the present study, while ruling out some possible sources of the effect, does not provide a definitive explanation for *why* perceived control moderates perceptual biases. Future research would ideally manipulate different psychological variables associated with perceived control (most importantly, predictability) to determine exactly which

aspect of perceived control is associated with the present findings and to better understand the underlying relations among these variables.

A second potential concern involves the role of demand effects in response to the experimental manipulation. This concern would be particularly problematic if the primary hypothesis involved a main effect for the manipulation of control. However, in the present study we hypothesised and observed a three-way interaction between the control manipulation, word content, and hypochondriacal tendencies. In order for the findings to be explained by demand effects, the participants would have had to create a RT effect only for the anthrax words, and proportionate to their own hypochondriacal tendencies that were assessed using a measure with low face validity. Thus, an explanation that relies on demand effects seems unlikely.

## CONCLUSIONS

The present findings extend the existing literature examining the self-regulation of health-threatening information by interrelating two factors that have rarely been considered in tandem: (1) stable individual differences in hypochondriacal tendencies; and (2) perceived control over a health threat. It was shown that after activating illness concern, a perseveration bias for (attention to) threat-relevant stimuli increased as a function of individuals' hypochondriacal tendencies. That is, increased hypochondriacal tendencies result in a greater susceptibility to the observed perseveration bias. Finally, perceived control appears to moderate the perseveration effect, such that it only occurs when individuals' perceptions of control are manipulated so as 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). Because other psychopathological states are likewise associated with increased attention to threat cues (Mathews & MacLeod, 1994; Williams et al., 1996), the present experimental paradigm provides some direction for mitigating those effects as well.

## REFERENCES

- Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Newbury Park, CA: Sage.
- Averill, J. R. (1973). Personal control over aversive stimuli and its relationship to stress. *Psychological Bulletin*, *80*, 286–303.
- 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.
- Bransford, J. D. (1979). *Human cognition: Learning, understanding, and remembering*. Belmont, CA: Wadsworth.
- Cioffi, D. (1991). Beyond attentional strategies: A cognitive-perceptual model of somatic interpretation. *Psychological Bulletin*, *109*, 25–41.
- Clark, D. M. (1988). A cognitive model of panic attacks. In S. Rachman & J. D. Moser (Eds.), *Panic* (pp. 71–89). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- 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.
- Eckhardt, C. I., & Cohen, D. J. (1997). Attention to anger-relevant and irrelevant stimuli following naturalistic insult. *Personality and Individual Differences*, *23*, 619–629.
- Foa, E. B., & Kozak, M. J. (1993). Pathological anxiety: The meaning and structure of fear. In N. Birbaumer & A. Öhman (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.
- Glass, D. C., Singer, J. E., Leonard, H. S., Krantz, D., Cohen, S., & Cummings, H. (1973). Perceived control of aversive stimulation and the reduction of stress responses. *Journal of Personality*, *41*, 577–595.
- Hanback, J. W., & Revelle, W. (1978). Arousal and perceptual sensitivity in hypochondriasis. *Journal of Abnormal Psychology*, *87*, 523–530.
- 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., & Matthews, A. (1992). Interpretation of bodily symptoms in hypochondriasis. *Behaviour Research and Therapy*, *30*, 223–234.
- Ia-Heij, W., Van-der-Heijden, A. H., & Schreuder, R. (1985). Semantic priming and Stroop-like interference in word-naming tasks. *Journal of Experimental Psychology: Human Perception and Performance*, *11*, 62–80.
- Kahneman, D. (1973). *Attention and effort*. Englewood Cliffs, NJ: Prentice Hall.
- Kellner, R. A. (1986). *Somatization and hypochondriasis*. New York: Praeger.
- Langer, E. J., Janis, E. L., & Wolfer, J. A. (1975). Reduction of psychological stress in surgical patients. *Journal of Research and Therapy*, *31*, 17–24.
- Lavy, E. 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. (2004). An essential tool for the treatment and study of adult hypochondriasis [Review of the book *Hypochondriasis: Modern perspectives on an ancient malady*]. *Contemporary Psychology*, *49*, 88–91.
- 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.
- 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. (1991). Half a century of research on the Stroop effect: An integrative review. *Psychological Bulletin*, *109*, 163–203.

- 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.
- Matthews, G., & Harley, T. A. (1996). Connectionist models of emotional distress and attentional bias. *Cognition and Emotion*, 10, 561–600.
- McNally, R. J. (1990). Psychological approaches to panic disorder: A review. *Psychological Bulletin*, 108, 403–419.
- Melara, R. D., & Algom, D. (2003). Driven by information: A tectonic theory of Stroop effects. *Psychological Review*, 110, 422–471.
- 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.
- Miller, S. M. (1979). Controllability and human stress: Method, evidence and theory. *Behaviour Research and Therapy*, 17, 287–304.
- Mogg, K., & Bradley, B. P. (1998). A cognitive-motivational analysis of anxiety. *Behaviour Research and Therapy*, 36, 809–848.
- Norman, D. A., & Bobrow, D. J. (1975). On data-limited and resource-limited processing. *Cognitive Psychology*, 7, 44–64.
- Persons, J. B., & Miranda, J. (1992). Cognitive theories of vulnerability to depression: Reconciling negative evidence. *Cognitive Therapy and Research*, 16, 485–502.
- 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.
- 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.
- Thompson, S. C., & Wierson, M. (2000). Enhancing perceived control in psychotherapy. In C. R. Snyder & R. E. Ingram (Eds.), *Handbook of psychological change: Psychotherapy processes and practices for the 21st century* (pp. 177–197). New York: Wiley.
- Warwick, H. M. (1989). A cognitive-behavioral approach to hypochondriasis and health anxiety. *Journal of Psychosomatic Research*, 33, 705–711.
- Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, 54, 1063–1070.
- Weinstein, N. D. (1984). Why it won't happen to me: Perceptions of risk factors and susceptibility. *Health Psychology*, 3, 431–457.
- Williams, J. M. G., Mathews, A. M., & MacLeod, C. (1996). The emotional Stroop task and psychopathology. *Psychological Bulletin*, 120, 3–24.
- Zvolensky, M. J., Eifert, G. H., Lejuez, C. W., & McNeil, D. W. (1999). The effects of offset control over 20% carbon-dioxide-enriched air on anxious responding. *Journal of Abnormal Psychology*, 108, 624–632.