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Running Head: DISEASE, SELF-PERCEPTION, AND BEHAVIOR

Infection Breeds Reticence:

The effects of a disease-avoidance prime on self-perceptions of personality and  
behavioral avoidance tendencies

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Abstract

Social living brings humans great rewards, but also associated dangers, such as increased risk of infection from others. Though the body's immune system is integral to combating disease, it is physiologically costly. Less costly are mechanisms for promoting avoidance of potentially infectious others, such as perceiving oneself as less social and increasing the tendency to make avoidant movements. In Experiment 1, a disease prime led people to rate themselves as less extraverted and those high in perceived vulnerability to disease (PVD) to rate themselves as less agreeable and less open to new experiences. In Experiment 2, a disease prime facilitated avoidant tendencies in arm movements when viewing photographs of faces, especially for perceivers high in PVD. Together, these findings reveal functional changes in perception and behavior that would serve to promote avoidance of potentially infectious others.

Infection Breeds Reticence: The effects of a disease-avoidance prime on self-perceptions  
of personality and behavioral avoidance tendencies

*“ ‘It’s as if the whole city is on holiday,’ said university geography teacher Manuel Molla as he ordered a coffee on the terrace of La Piazza cafe. By mid-morning he was still the only customer.”*

—Mexico City resident during swine flu outbreak, April 2009

Think for a moment about your colleagues. It is likely that you can think of one who is gregarious, open-minded, and easygoing—shaking hands, patting colleagues on the back, and laughing with everyone. Perhaps you’ve admired this colleague’s personality, as you’ve seen the benefits that come with it—collaborative projects, social networking, and favors exchanged. Indeed, group living confers many great benefits that can only be achieved through cooperative social interaction, and the more people with whom you surround yourself, the more you can take advantage of these benefits. Group living, however, also carries an associated price to be paid, as these beneficial others also unwittingly facilitate the spread of harmful diseases. At times, then, extraversion may not be beneficial, but costly. When there are harmful diseases in the environment, the benefits of being outgoing may be quickly outweighed by the costs of potential infection.

*The Behavioral Immune System*

The ability to combat pathogens is fundamental for survival. Although the body’s immune system is integral to this cause, its use is also physiologically costly (Brown, 2003; Klein & Nelson, 1999; Schaller & Duncan, 2007) and can therefore be thought of

as the body's last line of defense against disease, fighting infection only if it cannot be avoided in the first place. Given the historical prevalence of disease-causing organisms (Gangestad & Buss, 1993; Low, 1994) and the functional importance of avoiding them (Tybur, Lieberman, & Griskevicius, in press), it would be beneficial for people to also possess a "Behavioral Immune System" for preventing the initial transmission of pathogens (Schaller, 2006; Schaller & Duncan, 2007). This system should promote the early detection and behavioral avoidance of people exhibiting disease-relevant cues (Kurzban & Leary, 2001; Schaller, Park, & Faulkner, 2003) and, because of the potential costs of misses (false negatives) in identification, overgeneralization of these cues (Zebrowitz & Rhodes, 2004) to people exhibiting cues that are heuristically (though perhaps falsely) associated with disease (Haselton & Nettle, 2006). Indeed, evidence suggests that people concerned with disease-threat are especially sensitive to a wide range of such cues.

With respect to detection, disease-sensitive people pay relatively more attention to faces with even innocuous disfigurements (Ackerman et al., in press), and also perceive disabled individuals as having diseases unrelated to their disability (Park, Faulkner, & Schaller, 2003). A heightened sensitivity to disease should also motivate strategies for avoiding infection; one such strategy would be to adopt attitudes that reduce affiliation with others, particularly with those who exhibit characteristics that heuristically imply greater likelihood of disease. Indeed, people chronically concerned with disease are less likely to have friends with disabilities (Park et al., 2003), tend to dislike obese individuals more (Park, Schaller, & Crandall, 2007), and exhibit more xenophobic (Faulkner, Schaller, Park, & Duncan, 2004) and ethnocentric attitudes (Naverette & Fessler, 2006)

toward foreigners who may carry novel diseases and who may violate local customs that block disease transmission.

### *Self-relevant Strategies*

If the primary function of the behavioral immune system is to avoid contact with contagion, another beneficial response might be the biasing of *self-relevant* perceptions. Concern about disease may lead individuals to view themselves as desiring less social contact, especially with unfamiliar others. Further, such individuals should not only exhibit self-relevant biases, but also become more likely to act consistently with these self-ascriptions of reticence. Thus, people should display patterns of motor activity that promote the avoidant goal of the behavioral immune system. The current research explores these possibilities by testing whether exposing participants to information about the prevalence of communicable diseases increases avoidant tendencies in both self-perceptions and motor action, thus making it easier for individuals to avoid potentially infectious contacts with others.

### *Personality Traits*

If one component of a behavioral immune system involves biasing self-perceptions toward unsociability, we can make predictions regarding specific personality traits that should change in response to a disease threat. Though personality traits are stable across time, by definition, and have been found to have substantial temporal and cross-situational consistency, there are also likely to be non-random fluctuations in where any given person views oneself along a given trait dimension (Funder, 2006). Temporarily adjusting self-perceptions on these dimensions would be a valuable ally in the fight against infection. In terms of the Big Five personality traits (Goldberg, 1990;

John & Srivastava, 1999; McCrae & Costa, 1997), increasing the desire to avoid others should first involve lowering self-perceived Extraversion (i.e., seeing oneself as more passive and socially reserved) and Agreeableness (i.e., seeing oneself as more hostile and distrustful) (Goldberg, 1993). As unfamiliar others should be expected to pose an especially potent threat of disease transmission (Faulkner et al., 2004), a behavioral immune system might also trigger lowered self-perceptions of Openness to Experience, a personality trait negatively correlated with intolerant attitudes toward (and therefore avoidance of) outgroups, such as anti-gay attitudes, ethnocentrism, and right-wing authoritarianism (Butler, 2000).

Changes in self-perceptions in response to a disease threat may not be uniform across all people. Rather, these changes should be moderated by individuals' perceptions of vulnerability to this threat. Those who feel chronically invulnerable to disease are unlikely to exhibit personality changes that would lead to disease avoidance, whereas those who feel especially vulnerable to disease should exhibit greater changes, as these individuals should feel a more potent threat posed by disease in the environment.

### Experiment 1

Experiment 1 tested whether self-perceptions along Big Five personality trait dimensions exhibit functional changes in response to disease salience. That is, following exposure to a slideshow that primed thoughts of disease prevalence, we expected participants to report significantly lower scores in Extraversion, Agreeableness, and Openness to Experience. Furthermore, we expected that these changes would be exaggerated among those who feel especially vulnerable to disease.

*Method*

*Participants.* Fifty-nine introductory psychology students (30 female) participated in exchange for partial fulfillment of a course requirement and were randomly assigned to either a disease prime or control condition.

*Procedure.* Participants entered the lab in groups of five or fewer and were seated in front of computers separated by large cubicle walls. They were told that because the study did not take the full hour allotted, they would be asked to view and give feedback on a slideshow that would be used by other researchers in a future study as a cover story to mask the true intention of the slideshow to serve as a prime. The slideshow featured pictures and information regarding germs and contagious disease transmission in the disease-sensitivity prime condition or innocuous architecture in the control prime condition (Ackerman et al., in press; Faulkner et al., 2004). After viewing the slideshow, they first responded to questions regarding the inferred purpose of the slideshow and number of slides it featured to corroborate the cover story. Then, to increase the impact of the slideshow, participants were asked to write about a time they had encountered something similar to what they had just seen. For example, one participant in the disease prime condition wrote, "I've had chicken pox before. I've gotten sick from somebody else coughing or breathing on me." Participants' responses in the control condition were not relevant to disease, such as, "I have seen many buildings that look similar to the ones in the slide show. Some seem like government places and others seem like normal houses that you see all the time in movies and pictures."

After viewing the slideshow, participants were asked to answer some questions about themselves and completed the 44-item Big Five Inventory (John & Srivastava,



1999), which measures participants' self-reported levels of Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness. After a delay of approximately 30 minutes, during which participants watched an innocuous movie clip and completed a second study, participants completed the 18-item Perceived Vulnerability to Disease (PVD) scale (Park et al., 2003), which measures participants' beliefs in their own susceptibility to illness. The long delay was designed to allow us to measure PVD independent of the prime. As expected, t-tests revealed no significant differences in scores on the PVD scale between conditions.

Participants were then asked for demographic information, probed for suspicion, fully debriefed, and dismissed.

### *Results and Discussion*

Some participants proceeded too quickly through the slideshow to be properly exposed to the prime. To correct for skew, a log transformation was performed and participants with viewing times more than 2 standard deviations below the mean of 80.22 seconds (i.e., less than 18.11 seconds) were eliminated (remaining  $N = 54$ ).

Composite scores for each of the Big 5 dimensions were computed using the procedures in John and Srivastava (1999). Linear regression analyses were conducted with Disease Prime, centered PVD, participant sex, and the resulting interactions predicting Big Five Inventory scores. No effects of sex were detected.

Analyses revealed, first, a significant Disease Prime X PVD interaction on Openness,  $\beta = -.329$ ,  $t = -2.366$ ,  $p = .022$ , and a marginal effect on Agreeableness,  $\beta = -.262$ ,  $t = -1.798$ ,  $p = .079$ . Analyses conducted at 1 SD above and below the mean PVD score (Aiken & West, 1991) showed that, among those high in PVD, the disease prime

caused significant decreases in Openness,  $\beta = -.544$ ,  $t = -2.698$ ,  $p = .010$ , and Agreeableness,  $\beta = -.436$ ,  $t = -2.065$ ,  $p = .045$ . Those low in PVD were relatively unaffected ( $|t/s| < .62$ ,  $ps > .53$ ); see Figure 1.

Second, there was a significant effect of the Disease Prime on Extraversion,  $\beta = -.337$ ,  $t = -2.456$ ,  $p = .018$ . The Disease Prime did not interact significantly with PVD however,  $\beta = -.102$ ,  $t = -.740$ ,  $p = .463$ , indicating that the Disease Prime was sufficiently strong to decrease Extraversion across all levels of PVD (see Figure 1).

-----Figure 1 about here-----

Finally, there were no significant Disease Prime, PVD or Disease Prime X PVD effects on Conscientiousness or Neuroticism (all  $ps > .198$ ).

Overall, these findings show that, despite the general stability of personality traits over time, worries about disease led to functional changes in people's self-perceived sociality: A situationally activated disease threat generally led participants to view themselves as less gregarious and, for participants chronically concerned with disease, as less open-minded toward new people and experiences and as less cooperative with others.

## Experiment 2

Past research has shown that thoughts of disease lead to negative evaluations of others (Faulkner et al., 2004; Park et al., 2007), and we found in Experiment 1 that thoughts of disease lead people to perceive themselves as less inclined to seek the company of others. However, these changes in perceptions of others and the self would function to prevent infection from dangerous contagions only if there are corresponding changes in behavioral responses (Kenrick & Shiota, 2008). So, when attempting to avoid disease, people should not only exhibit decreased affiliative tendencies via attitudes

regarding the self and others, but also exhibit heightened behavioral avoidant tendencies in response to others.

There is evidence that people have an automatic tendency to develop attitudes toward all stimuli (e.g., Duckworth, Bargh, Garcia, & Chaiken, 2002), serving the function of producing immediate tendencies to approach or avoid them (Chen & Bargh, 1999; Solarz, 1960). In studies by Chen and Bargh (1999), participants were exposed to positive or negative stimuli and pushed or pulled a lever in response. Across two experiments, participants were quicker to make an avoidant movement (i.e., push away with an arm extension; see also Cacioppo, Priester, & Berntson, 1993; Priester, Cacioppo, & Petty, 1996) when responding to a negative stimulus than a positive one. Similarly, Duckworth and colleagues (2002) found that participants were faster to identify novel, positive stimuli when flexing their arms, but faster to identify novel, negative stimuli when extending them.

Furthermore, automatic evaluations can be influenced by primed goals (Ferguson & Bargh, 2004). Transitively, then, it is likely that a primed goal can affect subsequent behavioral approach and avoidance tendencies. Considering this, as well as the changes in evaluations of others after a disease prime, and the changes in self-perceptions demonstrated by the current research, we should then expect a corresponding change in behavioral approach and avoidance tendencies to social stimuli in response to a disease prime. We investigate here whether exposure to a disease prime facilitates avoidant (i.e., arm extension) movements and impedes approach (i.e., arm flexion) movements.<sup>1</sup>

We investigated this possibility by priming thoughts of disease then exposing participants to photographs of others and measuring the speed with which participants were able to make requested approach and avoidant movements.

### *Method*

*Participants.* One-hundred thirty one introductory psychology students (52 female) participated in exchange for partial fulfillment of a course requirement.

*Materials.* Participants underwent the same priming procedure as in Experiment 1. Approach-avoidance movements were measured using a shape identification task in which a computer keyboard was rotated 90 degrees clockwise. Participants were asked to press a key labeled “next” in the middle of the keyboard (i.e., the ‘?’ key) to start each of a series of 32 trials. In each trial, a central fixation point (+) appeared in the center of a 17-inch (15.7 in. viewable area) CRT monitor for 1000 ms followed by a 150- by 200-pixel photograph of a neutrally expressive male or female face for 500 ms. The photograph then briefly disappeared and was replaced by either a circle or square for 75 ms until the photograph reappeared. Participants were asked to identify the shape that had appeared by moving their hand from the center position and pressing any one of a bank of nine buttons labeled with circles (keys q, w, e, a, s, d, z, x, and c) or with squares (keys 1-9 on the numerical keypad), and to do so as quickly as possible. These responses required arm extension or flexion movements, respectively. We measured response time as an indicator of the speed with which these movements were made. Whether a face was paired with a circle or square was counterbalanced, and the order in which faces and shapes appeared was randomized.

*Procedure.* Participants were told that the study was about vision and that we were interested in how people identify objects in different environments. To explore this, participants were asked to quickly identify circles or squares by pressing any one of the keys marked with a circle or a square on the keyboard with the index finger of their dominant hand. They were told that the shapes would appear behind photographs of people or objects to better simulate a real world search, and that we had rotated the keyboard because in its normal position people find it easier to press the bank of keys associated with their dominant hand. Participants then proceeded to take part in a series of 10 practice trials with photographs of animals instead of people.

Next, participants experienced the same priming procedure used in Experiment 1, followed by the shape identification task. Following this, participants were exposed to the same filler movie used in Experiment 1 and then completed the PVD scale. Finally, participants were asked for demographic information, probed for suspicion, and fully debriefed. After demonstrating the position of the keyboard during the shape identification task to the experimenter to ensure they had not incorrectly rotated it, they were dismissed.

### *Results and Discussion*

One participant who scored below the chance level of 50% on the shape identification task was deemed noncompliant with instructions and removed from analyses. Only correct responses were included in analyses (accuracy = 99.32%), and trials in which participants responded greater than 3 standard deviations slower than the mean response time (2.3% of all trials) were removed, as well as those faster than 250 ms (0.8% of trials), as these responses were likely to have been made before the actual shape

could have been identified (e.g., Ferguson & Bargh, 2004). As with the first experiment, participants who progressed through the slideshow more than 2 SD faster than the mean viewing time were removed (remaining  $N = 125$ ).

For the main analysis, we calculated difference scores by subtracting the response times in trials that required flexion movements from those that required extension movements (Priester et al., 1996). Higher scores therefore represent greater motoric attraction on the part of participants, while lower scores represent repulsion.

Linear regression analyses were conducted with primed motivation, participant sex, PVD (centered), and the interactions between these variables predicting the arm movement reaction times. Results showed a significant main effect of motivation such that those primed with disease concerns had significantly lower motoric attraction than those in the control condition,  $\beta = -.241$ ,  $t = -2.402$ ,  $p = .018$ ; see Figure 2. Exploration of approach and avoidance movements separately revealed a significant interaction of primed motivation and PVD for avoidant movements  $\beta = -.209$ ,  $t = -2.041$ ,  $p = .043$ . Examining this effect at 1 SD above and below the mean PVD score revealed that those who chronically feel vulnerable to disease made avoidant movements significantly more quickly when primed with disease avoidance,  $\beta = -.337$ ,  $t = -2.590$ ,  $p = .011$ , but those low in PVD did not show these effects,  $\beta = .085$ ,  $t = .537$ ,  $p = .592$ . No significant effects were found for approach movements.

-----Figure 2 about here-----

In sum, a disease prime increased motoric repulsion from photographs of others. This change was largely driven by the tendency for those who felt vulnerable to disease

to make avoidant movements in response to the photographs. These findings support the idea that thoughts of disease promote the behavioral avoidance of others.<sup>2</sup>

### General Discussion

The results of these two studies showed that increasing the salience of disease in the environment led to changes in both self-perceptions and motor activation that would facilitate interpersonal avoidance. These changes appeared especially powerful in individuals whose perceived vulnerability to disease was high. Specifically, in Experiment 1, people chronically concerned with disease evaluated themselves as less Agreeable and less Open to Experience when primed with a disease threat. Regardless of individual differences in PVD, disease salience led people to rate themselves as less Extraverted. An increase in disease salience also increased the speed with which people made avoidant movements to neutral faces in Experiment 2. These results reveal two new facets of a proposed behavioral immune system: Engagement of this system can (1) affect perceptions of the self and (2) produce changes in motor activation, both of which would facilitate future avoidance behaviors.

Additional supporting evidence for the covariation between disease salience and self-perceptions has been recently provided by Schaller and Murray (2008), who analyzed findings from three studies that measured Big Five personality traits in different regions across the globe. Their findings showed that regional disease prevalence is negatively associated with Extraversion and Openness to Experience, as well as with sociosexuality (the degree to which one is open to short-term, uncommitted relationships). Though they did not find unequivocal support for differences in Agreeableness as we found, they did find a significant correlation between Agreeableness

and disease prevalence in the predicted direction in one of the three studies they analyzed.

Schaller and Murray (2008) presented three possible explanations for these findings. First, natural selection might favor different personality traits as a function of a region's disease prevalence. Second, the same set of genes may express itself differently depending on the prevalence of disease in the environment. The third explanation is that cultural norms may differ between regions and prescribe different personality characteristics depending on disease prevalence. Though the current research does not provide evidence against any of these explanations, it appears to provide support for a fourth process that may work in tandem with one or more of the other proposed mechanisms. That is, it appears that humans possess a mechanism that responds to environmental cues of disease and modulates attitudes and behaviors accordingly in functionally appropriate manners.

#### *Limitations and Future Directions*

Although we now have evidence that disease salience leads to changes in self-perceptions, other-perceptions, and behavioral tendencies, the nature of the causal process is still unclear. There is other evidence that changes in motivation or the salience of disease lead to subsequent changes in perceptions (e.g., Maner et al., 2005; Schaller & Duncan, 2007) and perhaps behavioral changes follow these changes. However, it is also the case that changes in behavioral intentions or actual behaviors can be caused directly by primed goals or motivations (Ferguson & Bargh, 2004; Griskevicius, Goldstein, Mortensen, & Cialdini, 2006), and it may be that self-perceptions might merely change epiphenomenally. Priester et al. (1996) found that manipulated approach and avoidant



arm movements affected people's evaluations of novel nonsense words such that the words were liked more after making approach movements and less after avoidant movements, and classic research has shown that behaviors can influence self-perceptions, such that judgments of one's own opinions and attitudes can change to match past behavior (e.g., Bem, 1967; Festinger & Carlsmith, 1957). Although approach and avoidant movements did not precede personality ratings in Experiment 1, even in the absence of overt approach or avoidance behaviors, changes in pre-motor activation may affect self-perceptions. Research on embodied or grounded cognition, which holds that "bodily states can cause cognitive states" (Barsalou, 2008, p. 617), has demonstrated the close tie between bodily movement and related cognitions (e.g., Glenberg & Kaschak, 2002; Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005). Thus, investigation into the mediating processes involved in the activation of the behavioral immune system could be a fruitful direction for future research.

### *Conclusion*

The present research shows that disease salience can influence affiliative tendencies in the form of self-perceptions of chronic personality traits. Furthermore, disease salience also facilitates avoidance behavior in response to others. Although the physiological immune system offers an essential defense against contagious disease, it is costly to use and not always successful. A better strategy may be to avoid infection in the first place by use of the behavioral immune system. Despite the benefits of group living, other people are conduits through which pathogens are transmitted, and as disease becomes more salient in the environment, the behavioral immune system calibrates people's attitudes and behaviors in ways that minimize potentially harmful social contact.

The current results combine with other recent findings to suggest that infection breeds reticence in ways that have broad-ranging effects on social behaviors at several levels.

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Footnotes

<sup>1</sup> This would be interesting not only because it would help fill out the picture of the behavioral immune system, but also because it would indicate that priming can produce overall changes in behavioral approach and avoidance tendencies to neutral stimuli, in addition to facilitating/inhibiting responses to stimuli congruent/incongruent with the prime.

<sup>2</sup> Though we measured implicit behaviors, these results may also support a tentative suggestion by Ferguson and Bargh (2004) that automatic evaluations are predictive of explicit behavioral intentions.

Figure Captions

*Figure 1.* Regression estimates of Big Five Inventory personality trait scores in each prime condition estimated at mean PVD, 1 SD above the mean, and 1 SD below, Experiment 1.

*Figure 2.* Difference between reaction times for extension and flexion movements in each prime condition estimated at mean PVD, 1 SD above the mean, and 1 SD below (lower scores represent greater speed for avoidant movements), Experiment 2.

Figure 1.

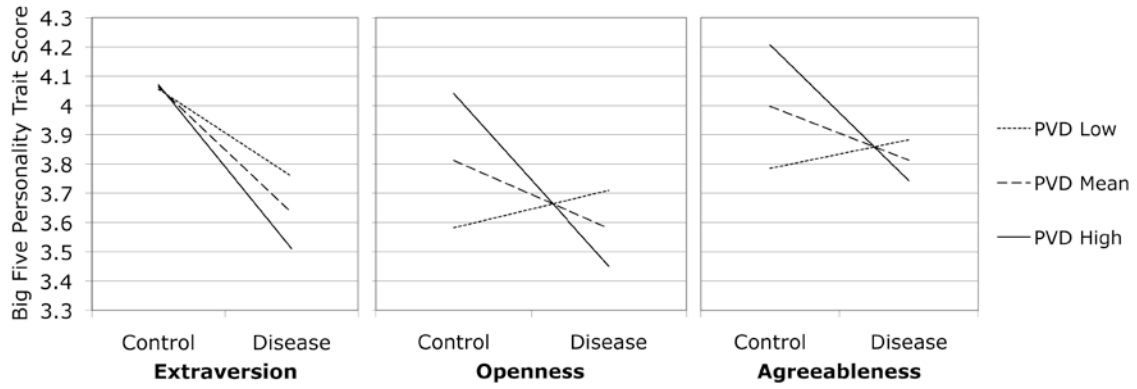


Figure 2.

