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Infection Breeds Reticence: The Effects of Disease Salience 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. Although the body's immune system is integral to combating disease, it is physiologically costly. Less costly are evolved mechanisms for promoting avoidance of people who are potentially infectious, such as perceiving oneself as less social and increasing the tendency to make avoidant movements. In Experiment 1, exposure to a disease prime led participants to rate themselves as less extraverted than did exposure to a control prime, and led participants high in perceived vulnerability to disease (PVD) to rate themselves as less agreeable and less open to experience than did exposure to a control prime. In Experiment 2, a disease prime facilitated avoidant tendencies in arm movements when participants viewed photographs of faces, especially for participants high in PVD. Together, these findings reveal functional changes in perception and behavior that would serve to promote avoidance of potentially infectious individuals.

Keywords

disease, personality, avoidance, automaticity, automatism, behavior, priming, motor processes

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> '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. (Tuckman, 2009, describing the H1N1 outbreak in Mexico City)

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 have admired this colleague's personality, as you have seen the benefits that come with it—collaborative projects, social networking, and favors exchanged. Indeed, group living confers many great benefits that can be achieved only 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, as interacting with beneficial people also facilitates 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). The immune system 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 (Curtis & Biran, 2001; Tybur, Lieberman, & Griskevicius, 2009), it would be

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beneficial for humans to have also evolved 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 missed identification (false negatives), the overgeneralization of these cues (Zebrowitz & Rhodes, 2004) to people exhibiting cues that are heuristically (though perhaps falsely) associated with disease (Haselton & Nettle, 2006). Furthermore, given the costs of avoiding new people and environments, the expression of disease-avoidance tendencies should not be invariant, but rather should differ both between contexts, depending on the degree to which a disease threat is present (Ackerman et al., 2009; Faulkner, Schaller, Park, & Duncan, 2004; Fessler & Navarrete, 2003; Park, Faulkner, & Schaller, 2003), and within contexts, depending on individual differences in the calibration of sensitivity to disease cues (Faulkner et al., 2004; Navarrete & Fessler, 2006; Park et al., 2003; Park, Schaller, & Crandall, 2007). Indeed, evidence suggests that people concerned with disease threats are especially sensitive to a wide range of such cues.

With respect to detection, disease-sensitive people pay more attention to faces with even innocuous disfigurements than do people who are not disease sensitive (Ackerman et al., 2009) and perceive disabled individuals as having diseases unrelated to their disability (Park et al., 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 other people, particularly with those who exhibit characteristics that heuristically imply greater likelihood of disease. Indeed, compared with people who are not concerned with disease, people who are concerned with disease are less likely to have friends with disabilities (Park et al., 2003), tend to dislike obese individuals more (Park et al., 2007), and exhibit more ethnocentric attitudes (Navarrete & Fessler, 2006) as well as more xenophobic attitudes (Faulkner et al., 2004) toward foreigners who may carry novel diseases or violate local customs that block disease transmission.

Self-Perceptual and Behavioral Strategies

If the primary function of the behavioral immune system is to avoid contact with contagion, another beneficial response to disease concerns might involve biasing self-perceptions, such that individuals would view themselves as desiring less social contact, especially with unfamiliar people. Further, such disease-concerned individuals should not only exhibit self-relevant biases, but also become more likely to act consistently with these self-ascriptions of reticence than when not concerned with disease. Thus, when the concept of disease is salient, people should display patterns of motor activity that promote the avoidant goal of the behavioral immune system. Our current research explored these possibilities by testing whether increasing disease salience heightens avoidant tendencies in both self-perceptions and motor action, thus facilitating the avoidance of potentially infectious contacts with other people.

Personality Traits

If one component of a behavioral immune system involves biasing self-perceptions toward unsociability, then one can make predictions regarding specific personality traits that should vary in conjunction with disease threat. In terms of the Big Five personality traits (John & Srivastava, 1999), increasing desire to avoid others should 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). Because people who are unfamiliar 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, which is negatively correlated with intolerant attitudes toward (and therefore avoidance of) outgroups, such as antigay attitudes, ethnocentrism, and right-wing authoritarianism (Butler, 2000).

Supporting this reasoning, Schaller and Murray (2008) found cross-cultural evidence that personality traits vary by geographic region in conjunction with regional levels of disease prevalence. Increased disease prevalence was associated with lower levels of extraversion, openness to experience, and, in one sample, agreeableness. Although personality traits within individuals are stable across time by definition, and have substantial cross-situational consistency, it is likely that there are nonrandom fluctuations in how any given person views himself or herself along a given trait dimension (Funder, 2006). Because temporarily adjusting self-perceptions on personality dimensions associated with sociability would be a valuable ally in the fight against infection, we expected extraversion, openness to experience, and agreeableness to decrease systematically in response to temporary increases in disease salience.

Additionally, as mentioned earlier, changes in response to a disease threat are not uniform across all people. This should also be the case for changes in self-perceptions, which should be moderated by individuals' self-perceived vulnerability to disease (Duncan, Schaller, & Park, 2009). Individuals who feel chronically invulnerable to disease are unlikely to exhibit strong personality changes promoting disease avoidance, whereas those who feel especially vulnerable to disease should exhibit greater changes, as these individuals should be more sensitive to the presence and absence of disease threats in the environment.

Experiment 1

Experiment 1 tested whether self-perceptions along the Big Five personality trait dimensions exhibit functional changes in

response to disease salience. Specifically, we expected that participants who viewed a slide show that primed thoughts of disease prevalence would report significantly lower extraversion, agreeableness, and openness to experience than participants who viewed a control slide show. Furthermore, we expected these changes to be exaggerated among participants who felt especially vulnerable to disease.

Method

Participants. Fifty-nine introductory psychology students (30 female and 29 male) participated in exchange for partial fulfillment of a course requirement and were randomly assigned to either the disease-prime or the control condition.

Procedure. Participants entered the lab in groups of 5 or fewer and were seated in front of computers separated by large cubicle walls. They were then told that because the study did not take the full hour allotted, they would be asked to view a slide show and give feedback that would be used by other researchers in a future study. This cover story served to mask the slide show's true purpose as a prime. The slide show in the disease-prime condition featured pictures and information regarding germs and transmission of contagious disease, and the slide show in the control condition featured innocuous architecture (Ackerman et al., 2009; Faulkner et al., 2004). Participants advanced the slides at their own pace.

To corroborate our cover story, we had participants respond to questions regarding the inferred purpose of the slide show and the number of slides it featured. Then, to increase the impact of the slide show, we asked participants to write about a time when 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. For example, a participant wrote, "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 slide show and answering the questions about it, participants completed the 44-item Big Five Inventory (John & Srivastava, 1999), which measures self-reported levels of extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience. After a delay of approximately 30 min, during which participants watched an innocuous movie clip and completed a second study, they competed the 18-item Perceived Vulnerability to Disease (PVD) scale (Park et al., 2003), which measures perceived susceptibility to illness. The long delay was designed to allow us to measure PVD independently of the prime. Participants were then asked for demographic information, probed for suspicion, debriefed, and dismissed.

Results and discussion

As expected, *t* tests revealed no significant differences in scores on the PVD scale between conditions. Some participants proceeded too quickly through the slide show to be properly exposed to the prime. To correct for skew, we performed a log transformation, and participants with viewing times more than 2 standard deviations below the mean of 80.22 s (i.e., less than 18.11 s) were eliminated (remaining $n = 54$).

Composite scores for each of the Big Five dimensions were computed using the procedures in John and Srivastava (1999). We conducted linear regression analyses predicting Big Five Inventory scores from prime condition (disease vs. control), centered PVD score, participant's sex, and the interactions of these variables. No effects of sex were detected, so this factor was removed from analyses.

Analyses revealed, first, a significant interactive effect of prime condition and PVD score on openness to experience, $\beta = -0.322$, $t(50) = -2.341$, $p = .023$, and a marginal interactive effect of these variables on agreeableness, $\beta = -0.250$, $t(50) = -1.794$, $p = .079$. Analyses conducted at 1 standard deviation above and 1 standard deviation below the mean PVD score (Aiken & West, 1991) showed that, among participants high in PVD, the disease prime caused significantly lower levels of openness to experience, $\beta = -0.518$, $t(50) = -2.609$, $p = .012$, and agreeableness, $\beta = -0.486$, $t(50) = -2.417$, $p = .019$, than the control prime. Participants low in PVD were unaffected by prime condition, $|t|s < 0.703$, $ps > .485$ (see Fig. 1).

Second, there was a significant effect of prime condition on extraversion, $\beta = -0.302$, $t(50) = -2.258$, $p = .028$. However, in this case, prime condition did not interact significantly with PVD, $\beta = -0.139$, $t(50) = -1.011$, $p = .317$. Thus, the prime condition was sufficiently strong to decrease extraversion across all levels of PVD (see Fig. 1). There were no significant effects of prime condition or PVD, or their interaction, on conscientiousness or neuroticism.

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 led participants who were chronically concerned with disease to view themselves as less open-minded toward new people and experiences and less cooperative with others.

Experiment 2

Past research has shown that thoughts of disease lead to negative evaluations of other people (Faulkner et al., 2004; Park et al., 2007), and we found in Experiment 1 that disease salience lowered inclinations 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 were corresponding changes in behavioral

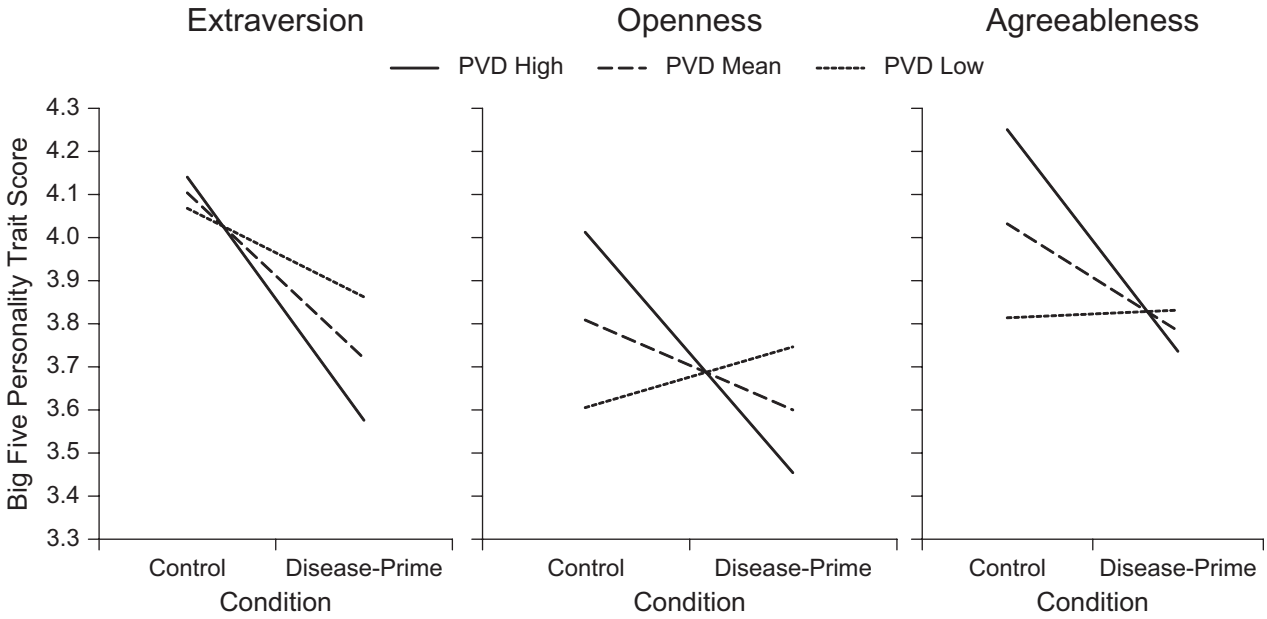

Fig. 1. Linear regression estimates of Big Five Inventory scores for extraversion, openness to experience, and agreeableness in each prime condition in Experiment 1. Each graph shows estimated personality scores for persons with perceived-vulnerability-to-disease (PVD) scores at the mean, 1 standard deviation above the mean, and 1 standard deviation below the mean.

responses (Kenrick & Shiota, 2008). So, in response to disease threat, 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.

People have an automatic tendency to develop attitudes toward stimuli (e.g., Duckworth, Bargh, Garcia, & Chaiken, 2002), a process that serves the function of producing immediate behavioral tendencies to approach or avoid them (Chen & Bargh, 1999; Solarz, 1960). In studies by Chen and Bargh, participants were exposed to positive or negative stimuli and then pushed or pulled a lever in response. Across two experiments, participants made movements associated with behavioral avoidance (i.e., extending the arm, as when pushing away an undesired object) faster when responding to a negative stimulus than when responding to a positive one. Similarly, Duckworth and her colleagues found that participants were faster to identify novel, positive stimuli when making movements associated with behavioral approach (i.e., flexing their arms, as when pulling a desired object toward oneself), but faster to identify novel, negative stimuli when extending their arms (see also Cacioppo, Priester, & Berntson, 1993; Priester, Cacioppo, & Petty, 1996; and Solarz, 1960, for additional examples of support for the link between these movements and approach/avoidance tendencies).

Furthermore, automatic evaluations can be influenced by primed goals (Ferguson & Bargh, 2004). Transitively, then, a primed goal should affect subsequent behavioral approach and avoidance tendencies. Considering this, as well as the changes we and other researchers have demonstrated in participants' self-perceptions and evaluations of other people after exposure to a disease prime, one should expect a corresponding change in behavioral approach and avoidance tendencies toward social stimuli in response to a disease prime. Thus, we investigated whether exposure to a disease prime facilitates avoidant movements (i.e., arm extension) and impedes approach movements (i.e., arm flexion) by priming thoughts of disease and then exposing participants to photographs of other people and measuring the speed at which they made prompted approach and avoidance movements.[1]

Method

Participants. One hundred thirty-one introductory psychology students (52 female and 79 male) participated in exchange for partial fulfillment of a course requirement.

Materials. Approach and avoidance movements were measured using a shape identification task in which a computer keyboard was rotated 90° clockwise. Participants were asked to press a key labeled "next" in the middle of the keyboard (the "?" key) to start each of a series of 32 trials. In each trial, a central fixation point ("+") was displayed in the center of a 17-in. (15.7-in. viewable area) CRT monitor for 1,000 ms and followed by a 150- × 200-pixel photograph of a neutrally expressive male or female face for 500 ms. The photograph was then briefly replaced by either a circle or a square for 75 ms, and then the photograph reappeared, completely obscuring the shape. Participants were asked to identify the shape 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 (the nine keys numbered 1 through 9 on the numerical keypad), and to do so as quickly as possible. These responses required

arm extension (circles) or flexion (squares). We measured reaction time as an indicator of the speed with which these movements were made. Face-shape pairings were counterbalanced, and the order in which faces and shapes appeared was randomized.

Procedure. Participants were told that the study was about vision and the identification of objects in different environments. Participants were asked to quickly identify circles or squares by pressing any one of the marked keys with the index finger of their dominant hand. They were told that the shapes would appear behind photographs of people or objects (although only photographs of people were used), to 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. They were then asked for demographic information, probed for suspicion, and debriefed. Last, participants demonstrated to the experimenter the position of the keyboard during the shape-identification task so that we could be sure they had not incorrectly rotated it, and then 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 the instructions and removed from analyses. Only correct responses were included in the analyses (accuracy = 99.32%). Trials in which participants responded more than 3 standard deviations more slowly than the mean (2.3% of all trials) were removed. We also removed trials in which reaction times were faster than 250 ms (0.8% of trials), as these responses were likely to have been made before the shape could have been identified (e.g., Ferguson & Bargh, 2004). As with the first experiment, participants who progressed through the slide show more than 2 standard deviations faster than the mean were removed (remaining $n = 125$).

We calculated difference scores by subtracting the mean reaction times in trials that required flexion movements from those that required extension movements (Cacioppo et al., 1993; Priester et al., 1996). Lower scores therefore represent greater motoric repulsion on the part of participants.

We conducted linear regression analyses predicting the differences in arm-movement reaction times from primed motivation, participant's sex, PVD (centered), and the interactions of these variables. As in Experiment 1, there were no effects of sex, so this variable was removed from the analyses. Results showed a significant main effect of motivation, such that participants primed with disease concerns showed significantly greater motoric repulsion than those in the control condition, $\beta = -0.190$, $t(121) = -2.147$, $p = .034$ (see Fig. 2). This main effect was qualified by a marginally significant interaction between primed motivation and PVD, $\beta = -0.152$, $t(121) = -1.712$, $p = .089$. Examining this effect at 1 standard deviation above and 1 standard deviation below the mean PVD score revealed that participants who chronically felt vulnerable to disease were significantly more biased toward behavioral avoidance when primed with disease than when exposed to a control prime, $\beta = -0.344$, $t(121) = -2.704$, $p = .008$, but those low in PVD did not show an effect of prime condition, $\beta = -0.037$, $t(121) = -0.294$, $p = .769$.

In sum, a disease prime increased motoric repulsion from photographs of other people, and this change was greater as participants' perceived vulnerability to disease increased. These findings support the idea that thoughts of disease promote the behavioral avoidance of other people.[2]

General Discussion

These two studies showed that increases in disease salience altered self-perceptions and motor activation in ways that facilitate interpersonal avoidance. These changes were especially powerful in individuals whose perceived vulnerability to disease was high. Specifically, in Experiment 1, people

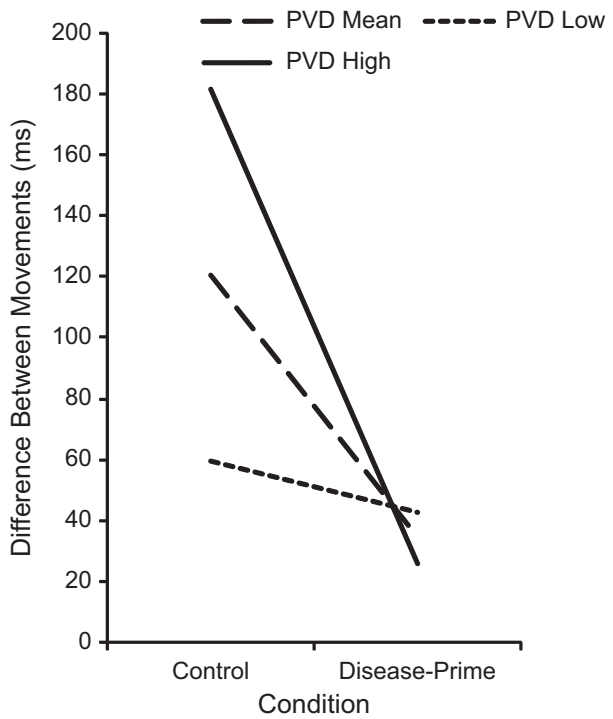

Fig. 2. Difference between reaction times for extension and flexion movements in each prime condition in Experiment 2. The graph shows estimated reaction times for persons with perceived-vulnerability-to-disease (PVD) scores at the mean, 1 standard deviation above the mean, and 1 standard deviation below the mean. Smaller reaction time differences represent greater speed for avoidant movements.

chronically concerned with disease evaluated themselves as less agreeable and less open to experience when primed with a disease threat than when exposed to a control prime. Regardless of individual differences in PVD, disease salience also led people to rate themselves as less extraverted. In Experiment 2, higher disease salience led to higher speeds in making avoidant movements to neutral faces, especially among individuals high in PVD. These results reveal two new facets of a proposed behavioral immune system: Engagement of this system can affect perceptions of the self and produce changes in motor activation, both of which would facilitate future avoidance behaviors.

Supporting these experimental findings, Schaller and Murray (2008) found that regional disease prevalence is negatively associated with extraversion, openness to experience, sociosexuality (the degree to which one is open to short-term, uncommitted relationships), and, in one of the three studies, agreeableness. They 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. Third, cultural norms may differ between regions and prescribe different personality characteristics depending on disease prevalence. The current research appears to provide support for a fourth process that may work alone or in tandem with one or more of the other proposed mechanisms. Specifically, it appears that humans have evolved a mechanism that responds to environmental cues of disease and modulates attitudes and behaviors in functionally appropriate ways.

Future directions

We consistently observed greater differences between participants in the control and experimental groups as PVD increased. We also sometimes observed positive associations between PVD and our dependent variables in the control conditions, although these differences were not statistically reliable. Just as greater PVD is associated with increased sensitivity to the presence of disease cues, this latter trend hints that PVD may also be associated with increased sensitivity to the absence of disease cues. In contrast with the slide show in the experimental condition, our control-condition slide show was designed to be entirely bereft of disease cues. It is possible that the stark absence of disease cues may have signaled, to high-PVD participants especially, a rare opportunity to actively engage the social world, thereby curtailing their usual avoidant tendencies. Further research is required to explore this and alternative explanations.

Additionally, although there is now evidence that disease salience leads to changes in self-perceptions, other-perceptions, and behavioral tendencies, the nature of the causal process is still unclear. Changes in motivations can lead to subsequent changes in perceptions (e.g., Maner et al., 2005; Schaller & Duncan, 2007), so perhaps the changes in behavior demonstrated in the current research follow changes in self- and other-perceptions. Alternatively, changes in behavior could be caused directly by primed goals or motivations (Ferguson & Bargh, 2004; Griskevicius, Goldstein, Mortensen, Cialdini, & Kenrick, 2006), and behaviors could affect subsequent evaluations of not only novel stimuli (Priester et al., 1996) but also the self (e.g., Bem, 1967; Festinger & Carlsmith, 1959). Research on embodied cognition proposes that "bodily states can cause cognitive states" (Barsalou, 2008, p. 617) and has demonstrated a close tie between body movements and related cognitions (e.g., Glenberg & Kaschak, 2002; Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005). Thus, although explicit approach and avoidance movements did not precede personality ratings in Experiment 1, even in the absence of overt behaviors, changes in premotor activation could have resulted from the priming manipulation and affected self-perceptions. Investigating the mediating processes involved in the activation of the behavioral immune system and the role of embodied cognition could be fruitful directions for future research.

Conclusion

The present research shows that disease salience can influence affiliative tendencies by changing self-perceptions of chronic personality traits and facilitating avoidant behavior in response to other people. Although the physiological immune system offers an essential defense against contagious disease, it is costly to use and not always successful. A better strategy is to avoid infection in the first place. Despite the benefits of group living, other people are vectors through which pathogens are transmitted. Along with other researchers, we suggest that as disease becomes more salient in the environment, the behavioral immune system calibrates people's attitudes and behaviors to minimize potentially harmful social contact. The current results combine with other recent findings to suggest that infection breeds reticence in ways that have effects on social behaviors at several levels.

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Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

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Notes

1. This design is also interesting because it could provide evidence that priming can produce changes in approach and avoidance behaviors in response to neutral stimuli, in addition to stimuli that are congruent or incongruent with a prime.
2. Although 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.

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