The Impact of Perceived Disease Threat on Women's Desire for Novel Dating and Sexual Partners: Is Variety the Best Medicine?

Sarah E. Hill, Marjorie L. Prokosch, and Danielle J. DelPriore
Texas Christian University

Researchers in the evolutionary sciences have long understood men's desire to mate with a variety of women. Because men's obligatory investment in offspring production is relatively small, men can directly increase their number of descendants by mating with multiple partners. Relatively less is known, however, about the conditions that favor sexual variety seeking in women. Drawing on insights from evolutionary biology and behavioral ecology, we examined the relationship between the perceived pathogen load in an environment and women's desire for sexual variety. Across 5 experiments, we primed women with cues indicating that the rate of disease is increasing in their environment. We then measured their desire for novel sexual and dating partners. Results revealed that women with a history of vulnerability to illness respond to these cues by desiring a greater number of novel partners. This shift was not found in men and did not predict variety seeking in a nonsexual domain. In addition to providing evidence of a novel conceptual link between the pathogen load and patterns of human mating behavior, this research also provides new insights into women's mating psychology and the conditions that favor sexual variety seeking in the greater investing sex.

Keywords: pathogens, disease threat, vulnerability to disease, evolutionary psychology, human mating

Across history, one does not need to search for long to find examples of men who exhibited a preference for variety—whether simultaneous or serial—in their mates. For example, King Kasyapa of Sigiriya, who ruled Sri Lanka from 473 to 495 CE, was believed to keep a harem of nearly 500 young women at a time (Ponnamperuma, 2013). Aztec ruler Montezuma II had nearly 4,000 concubines in his harem, guided by the dictum that every member of the Aztec nobility should have as many consorts as he could afford (Townsend, 2000). More recent examples of this phenomenon are regularly featured on the pages of tabloids and celebrity gossip magazines, where the sexual exploits of celebrities and sports figures, such as Donald Trump and Tiger Woods, illustrate what several decades of empirical work has confirmed: men have a greater desire for sexual variety than is typically observed in women (Buss, 1989; Buss & Schmitt, 1993; Schmitt, 2003).

Although women desire variety in their partners to a lesser extent than men, the preference for novel partners is not altogether absent among women. Among the Himbda society in southwestern Namibia, for example, female infidelity is an accepted part of married life. Nearly one third of Himbda women report engaging in extramarital affairs and many of these affairs result in pregnancy (Scelza, 2011). While it may be easy to dismiss the behavior of the Himbda as being an interesting exception to a well-supported rule, the Himbda women are not alone in their pursuit of a multiple male mating strategy. Between 15% and 30% of married women in the United States admit to having had extramarital affairs (Gangestad, Thornhill, & Garver-Apgar, 2005a), and the measured rate of extrapair paternity in Western populations is estimated to be over 10% (Anderson, 2006; Cerda-Flores, Barton, Marty-Gonzalez, Rivas, & Chakraborty, 1999; Sasse, Müller, Chakraborty, & Ott, 1994). Further, recent cross-cultural work has identified more than 50 traditional cultures whose mating systems are characterized by informal polyandry similar to that observed in the Himbda, including the Yanomami of Brazil, the Ekiti of Nigeria, and the Vanatinai of New Guinea (Johnson, 2013).

Despite growing research interest in the conditions that favor extrapair mating in women, particularly near ovulation (e.g., Gangestad, Thornhill, & Garver-Apgar, 2005b; Haselton & Gangestad, 2006), relatively less is known about the conditions that encourage women to seek variety, per se, in their dating and sexual partners. The current research seeks to address this empirical gap, examining whether women's desire for partner variety might be influenced by a factor that evolutionary scientists have long known to favor strategies that increase genetic variability among offspring: the threat posed by infection and disease in one's environment (see, e.g., Hamilton, 1980, 1982; Hamilton, Axelrod, & Tanese, 1990; Jaenike, 1978; Ridley, 1994; Smith, 1978). In addition to slowing the rate at which the diseases themselves evolve, genetic variability increases the likelihood that at least one of an individual's offspring will have the immune genes necessary to survive into adulthood (Petrie & Kem-

This article was published Online First June 1, 2015.

Sarah E. Hill, Marjorie L. Prokosch, and Danielle J. DelPriore, Department of Psychology, Texas Christian University.

We thank Amber Crawford and Jordan Suarez for their research assistance with this project.

Correspondence concerning this article should be addressed to Sarah E. Hill, Department of Psychology, TCU, Fort Worth, TX 76129. E-mail: s.e.hill@tcu.edu

Journal of Personality and Social Psychology, 2015, Vol. 109, No. 2, 244–261
 http://dx.doi.org/10.1037/pspi0000024

penaers, 1998; Vrijenhoek, 1993). Guided by these insights, the present research tested the hypothesis that women with a history of vulnerability to illnesses will respond to cues of an escalating disease threat by desiring a greater number of novel dating and sexual partners. By examining the effects of disease threat on women's desire for partner variety, the current research offers novel insights into women's mating psychology and provides evidence of a conceptual link between the threat of infection and disease in one's environment and observed patterns of human mating behavior.

The Benefits of Nonmonogamous Mating and the Desire for Partner Variety

From an evolutionary biological perspective, the adaptive benefits available to men from mating with multiple partners are fairly well understood (see, e.g., Buss & Schmitt, 1993; Gangestad & Simpson, 2000). Because reproduction only requires of men a relatively small obligatory investment (as little as a single act of sex), men can directly increase their number of descendants simply by successfully mating with a variety of women (Bateman, 1948; Symons, 1979; Trivers, 1972). For women, however, increased partner number itself does not have the potential to augment reproductive output beyond what could be attained from mating with a single partner. Because reproduction requires of women a minimum of 9 months, the ultimate fitness impact of their mating decisions is typically more tied to partner quality than partner quantity. The sexes therefore differ in the degree to which sexual variety seeking, per se, can translate into increased reproductive success, with men benefitting from strategies that emphasize partner novelty more than women. This benefit asymmetry is evidenced in men's and women's sex-differentiated mating psychology; several studies have found that men have a greater desire for sexual variety than do women (see, e.g., Buss & Schmitt, 1993; Schmitt, 2003; Schmitt, Shackelford, & Buss, 2001; Schmitt, Shackelford, Duntley, Tooke, & Buss, 2001).

Although the number of potential reproductive opportunities available to women does not increase with the addition of novel partners, pursuing a multimale mating strategy can still offer women important benefits that—in some conditions—might make this a more evolutionarily advantageous option than mating with a single partner (Barbosa, Dornelas, & Magurran, 2010; Birkhead & Møller, 1998; Greiling & Buss, 2000; Johnson, 2013). The most well-studied of these are the genetic benefits that a woman can secure for her offspring by way of engaging in extrapair mating (Gangestad, Garver-Apgar, Simpson, & Cousins, 2007; Gangestad et al., 2005a; Jennions & Petrie, 2000; Simmons, 2005). For example, because it is rare for an individual man to embody all of the qualities that women most desire in their mates—including attractiveness, social dominance, faithfulness, and the desire to have and invest in children—researchers have hypothesized that women may sometimes pursue a multimale mating strategy as a means of receiving resource investment from a primary partner while obtaining "good genes" for their offspring from a higher-quality, extrapair mate (e.g., Gangestad et al., 2007; Gangestad & Thornhill, 2003; Jennions & Petrie, 2000; Simmons, 2005; Thornhill & Gangestad, 2006). For example, research finds that women mated to men of relatively low genetic quality are more likely to desire sex with extrapair mates near ovulation when conception is possible—a shift not exhibited by women with higher quality mates (Gangestad et al., 2005a; Gangestad et al., 2005b; Haselton & Gangestad, 2006; Pillsworth & Haselton, 2006). Similar patterns have been observed among socially monogamous birds (Griffith, Owens, & Thuman, 2002; Petrie & Kempenaers, 1998; Westneat, Sherman, & Morton, 1990) and nonhuman primates (Fietz et al., 2000; Palombit, 1994; Reichard, 1995), suggesting that these shifts may be relatively ubiquitous among females in pair-bonding species.

A second benefit available to females from pursuing a multiple-male mating strategy is the increased genetic variability that results when one has offspring sired by different males (see, e.g., Barbosa et al., 2010; Kaplan & Cooper, 1984; Olofsson, Ripa, & Jonzén, 2009; Watson, 1991; Yasui, 1998, 2001). This, too, is evolutionarily advantageous in certain contexts. Having genetically diverse offspring promotes the long-term survivability of an individuals' offspring lineage when (a) the qualities that most impact survival and reproductive success in a given environment are not directly observable (i.e., females have to rely exclusively on indirect cues to assess qualities that are paramount to fitness in a given ecology); or (b) the environment is changing in ways that make it difficult to identify which males possess the traits that will fare well in future generations (Philippi & Seger, 1989). In such conditions, having genetically diverse offspring allows a female to hedge her bets by increasing the likelihood that at least one of her offspring will possess the traits necessary to promote survivability in future environments. Although mating strategies that promote genetic bet-hedging carry the costs associated with engaging in multiple mating and potentially lower reproductive success in the short-term, the *long-term* fitness benefits available from having genetically diverse offspring can be sufficiently large as to outweigh these costs (Gillespie, 1974, 1977; Seger & Brockmann, 1987; Simons, 2007). Animal models support this idea, demonstrating that diversified genetic bet-hedging strategies increase the survivability of females' offspring lineages in highly stochastic ecologies (see, e.g., Fox & Rauter, 2003; Philippi & Seger, 1989).

Sex, Disease, and the Red Queen

Does an increase in the threat posed by disease in one's environment reflect the type of stochastic environmental conditions that favor reproductive bet-hedging? Research in evolutionary biology suggests that it may. One of the primary defenses that organisms have evolved in response to pathogens and parasites—which evolve very rapidly—is the ability to create novel combinations of genetic defenses against them via sexual reproduction (the "Red Queen Hypothesis;" Hamilton, 1980; Van Valen, 1973). Although this mode of reproduction comes at the cost of losing 50% of one's genes in each subsequent generation, the fitness benefits that genetic variability provides one's offspring lineage in term of protection against disease is so great that it outweighs this substantial cost (Howard & Lively, 1994; Lively, 2010; Lively, Craddock, & Vrijenhoek, 1990; Salathé, Kouyos, Regoes, & Bonhoeffer, 2008). Genetic variability promotes the long-term survivability of an organism's genes by slowing the rate of disease transmission among one's relatives and increasing the likelihood that at least one of an individual's descendants will possess the genes necessary to survive into adulthood (Hamilton, 1980; Van Valen, 1973).

Given the advantages that genetic diversity offers in terms of managing pathogen threats, researchers have hypothesized that organisms may strategically vary their sexual strategies in ways that further increase genetic variability among their offspring when confronted with pathogen dense ecologies. For example, research conducted on the Seychelles warbler and Atlantic salmon each find that pathogen-

dense ecologies lead females to favor multimale mating strategies, with mean offspring lineage success being highest for those who have (the most genetically diverse) offspring sired by multiple males (Brouwer et al., 2010; Evans, Dionne, Miller, & Bernatchez, 2012). Analogous results have been found in studies of social insects; genetically diverse offspring colonies have been shown to be more resistant to disease than those that are more genetically similar, making bet-hedging the favored strategy for reproductive females when the risk of disease is high (Baer & Schmid-Hempel, 1999; Keller, 1995; Keller & Reeve, 1994, 1995; Liersch & Schmid-Hempel, 1998; Seeley & Tarpy, 2007; Tarpy, 2003; Tarpy & Seeley, 2006). Taken together, these results suggest that females may shift toward sexual strategies that promote genetic diversity among offspring in response to cues indicating a growing threat of morbidity/mortality from disease.

Is it possible that human females may also favor mating strategies that promote genetically variable offspring in pathogen dense ecologies? Research finds that women place a greater priority on cues of health, such as physical attractiveness and symmetry in response to pathogen cues (e.g., Gangestad & Buss, 1993; Lee & Zietsch, 2011; Young, Sacco, & Hugenberg, 2011). However, because health and immune function are not themselves directly observable, assessments based on these indirect markers are prone to error, particularly in industrialized nations where the pathogen load is low and even those with lower-quality immune genes can grow up free of disease and its physical remnants (see, e.g., Gangestad & Buss, 1993). Further, because the immune system is comprised of numerous systems and cell-types (e.g., T cells, B cells, NK cells, macrophages, neutrophils, eosinophils, basophils), even those who possess indirect indicators of immune competence in one domain may be vulnerable in others (see, e.g., Casanova, Abel, & Quintana-Murci, 2011; Delves, Martin, Burton, & Roitt, 2011; Horowitz et al., 2013; Murphy, 2011). Accordingly, in addition to prioritizing cues associated with health and developmental stability in pathogen dense ecologies, women might also benefit from strategically shifting their sexual strategies in ways that would promote genetic diversity among their offspring—increasing the likelihood that at least one will possess the specific immune genes necessary to survive in future environments.

Individual Differences in Vulnerability to Disease

For human females, a genetic bet-hedging strategy is potentially very costly. Women have historically relied heavily on male investment to promote their own survival and that of their children (see, e.g., Alexander & Noonan, 1979; Geary, 2000). Further, despite the role that genetic variability provides in minimizing the long-term threat of disease (see, e.g., Hamilton, 1980; Van Valen, 1973), a multiple-male mating strategy increases a woman's exposure to infection in the short-term. Mating with multiple men—whether in the form of serial monogamy or extrapair mating—is therefore risky for a woman, potentially decreasing the likelihood of receiving investment from any one of her partners (e.g., Anderson, Kaplan, & Lancaster, 1999; Apicella & Marlowe, 2004) and increasing her immediate risk of infection (Murray, Jones, & Schaller, 2013).

In light of these costs, disease threat cues should encourage mating strategies that promote genetic bet-hedging only among women who have the most to gain from having genetically diverse offspring. In particular, we expect that the growing threat of morbidity/mortality from disease should promote bet-hedging strategies among women whose personal histories with infection and disease suggest that they lack the immune genes necessary to promote survivability in pathogen dense ecologies. In such cases, the fitness benefits associated with genetic bet-hedging in terms of long-term offspring lineage success may be sufficiently large enough to outweigh the costs associated with the pursuit of a multimale mating strategy. For women whose personal vulnerability to disease and infection is low (i.e., they have a history of being able to withstand a variety of illnesses), however, the benefits associated with pursuing a genetic bet-hedging strategy may not be worth the substantial costs associated with multimale mating. Because these women are likely to already possess the genes necessary to increase offspring survivability in disease-dense environments, the fitness benefits available to them from a genetic bet-hedging strategy are unlikely to be substantial enough to outweigh the costs of multimale mating.

The Current Studies

Here, we present the results from five experiments in which we tested the impact of growing disease threat on women's desire for sexual variety. We predicted that women with a history of vulnerability to illness and disease would respond to disease threat cues by exhibiting a heightened desire for partner variety—a psychological shift known to play a key role in guiding the pursuit of multipartner mating (Buss & Schmitt, 1993; Schmitt et al., 2001). We tested this hypothesis in a series of experiments using multiple methods and measures. In each of our experiments, we primed participants with cues indicating a growing disease threat in their environment. This was then followed by a measure of their perceived vulnerability to disease and questions assessing their desire for novel sexual and dating partners. Experiment 1 measured women's ideal number of sex partners at various time points in the future. Experiment 2 elaborated on our first experiment by measuring women's desire for sexual novelty, per se, and whether these results are specific to disease threats that have the potential to impact the long-term survivability of a woman's offspring lineage. Experiment 3 examined the impact of disease threat cues on the number of novel partners that women chose in a hypothetical dating scenario, and Experiment 4 tested whether these effects generalize to men. In our last experiment (Experiment 5), we sought to conceptually replicate our pattern of results using a more ecologically valid dating task and a novel measure of personal immunocompetence (i.e., history of childhood illness). We also examined whether the effects are specific to women's desire for sexual variety or if they extend to women's desire for variety in a consumer product (i.e., nail polish).

Experiment 1: Effects of Disease Vulnerability on Women's Ideal Number of Sexual Partners

Experiment 1 was designed to examine whether cues indicating a growing threat of disease in one's environment would have an impact on women's desire for sexual variety. We predicted that women who perceive themselves to be most vulnerable to infection and disease would respond to these cues by desiring a greater number of novel partners in the future relative to women exposed to two alternative forms of environmental threat or uncertainty (resource scarcity and increasingly stringent academic standards).

Method

Participants. Participants were 84 heterosexual female undergraduates (M_{age} = 19.29 years, SD = 2.61; 25 in the disease threat condition, 31 in the resource scarcity condition, and 28 in the academic failure condition). All students received partial course credit in exchange for their participation.

Procedure and materials. Upon arrival to the experimental laboratory, participants were seated at privately partitioned computer terminals. All instructions and stimuli were presented via Qualtrics web based experimental software. Participants were told they would complete a study designed to explore the relationship between the specific format in which information is presented (e.g., text or picture format) and memory for that information. The computer program then randomly assigned participants to one of three photo slideshow conditions—one designed to elicit concerns about the growing threat of sickness and disease (experimental condition), one designed to elicit concerns about the threat of economic recession (control 1), or one designed to elicit concerns about academic failure (control 2). After viewing the slideshow to which they were assigned, participants answered some questions about the slideshow as a manipulation check (e.g., "How pleasant was the slideshow that you watched?") and a series of questions about their ideal number of sex partners. The experiment ended with participants filling out a short battery of demographic questions, including their perceived vulnerability to disease.

Priming conditions. Disease threat was primed by having participants view a slideshow that ostensibly summarized a recent news story from *Newsweek* magazine.[1] The slideshow was titled, "*The Growing Problem of Disease in America: A Sick Future Ahead*." This slideshow included captioned photos that told a story about how the rate of disease in America is increasing at a steady pace. The photos in the slideshow were chosen based on their illustrating a growing disease threat, but the images were devoid of cues that might elicit disgust. They included photos of doctors surrounding patients on hospital bed, a crowd of people in a train station wearing hospital masks to avoid H1N1 and avian flu, a picture of a mosquito carrying West Nile virus, and an ominous-looking histogram illustrating the Center for Disease Control's (CDCs) projected number of cancer cases for the next 20 years. Participants in the control conditions viewed one of two slideshows: one titled, "*The Economics of the 21st Century: A Harsh and Unpredictable World*," which portrayed photos of people struggling with the realities of an economic recession (see Hill, Rodeheffer, Griskevicius, Durante, & White, 2012). The second control slideshow was titled "*Making the Grade: No Longer a Walk in the Park*," which portrayed photos of stern looking college administrators and papers marked with big, red Fs (see Hill, DelPriore, Rodeheffer, & Butterfield, 2014). These slideshows were chosen as controls because each portrays a threat that was expected to produce similar levels of anxiety and hopelessness as the disease threat slideshow but were not expected to increase one's concern about the growing threat of disease in their environment. Participants viewed each slide in their assigned slideshow for 15 s.

A pretest was conducted to determine whether viewing the disease threat slideshow increased people's concerns about the growing threat of disease (compared with each of the other two conditions), without leading to differential feelings of disgust, anxiety, or hopelessness. To this end, a separate sample of 80 women (26 in the disease risk condition, 27 in each control condition) were randomly assigned via Qualtrics to view either the disease threat slideshow or one of the two control slideshows. After undergoing the priming procedure, participants responded to the following questions: (a) How hopeless did the slideshow make you feel?; (b) How worried about the future did the slideshow make you feel?; and (c) How disgusted did the slideshow make you feel? Participants also indicated the degree to which they agreed that: (d) infectious disease seems to be everywhere these days; (e) even with medical advances, it seems that disease is a greater problem than it used to be; (f) I am very likely to get sick later this year; and (g) I am likely to get a serious disease at some point in my life. All responses were made on 7-point rating scales. We predicted that the slideshows would not differ in the amount of disgust or uncertainty that they elicit, but that the disease threat slideshow would lead participants to believe that there is a greater risk of becoming seriously ill compared with the control slideshows.

Consistent with expectations, the three slideshows did not differ in the degree to which they made viewers feel hopeless (p = .66), worried about the future (p = .21), or disgusted (p = .46). Moreover, as predicted, the disease threat slideshow led participants to believe that: disease is everywhere these days ($M_{disease}$ = 5.00, SD = 1.36; $M_{scarcity}$ = 3.30, SD = 1.64; $M_{failure}$ = 3.37, SD = 1.36; $F(2, 77)$ = 9.90, $p < .001$, n_p^2 = .03); disease is a greater problem than it used to be ($M_{disease}$ = 4.38, SD = 2.00; $M_{scarcity}$ = 3.30, SD = 1.56; $M_{failure}$ = 3.33, SD = 1.52; $F(2, 77)$ = 3.46, p = .04, n_p^2 = .01); they are more likely to get sick that year ($M_{disease}$ = 4.65, SD = 1.67; $M_{scarcity}$ = 3.15, SD = 1.59; $M_{failure}$ = 3.26, SD = 1.75; $F(2, 77)$ = 3.22, p = .002, n_p^2 = .02); and they are more likely to catch a serious illness in their lifetime ($M_{disease}$ = 3.38, SD = 1.84; $M_{scarcity}$ = 2.52, SD = 1.51; $M_{failure}$ = 2.30, SD = 1.75; $F(2, 77)$ = 3.22, p = .05, n_p^2 = .02). Thus, as expected, the disease threat slideshow led participants to believe that there is a growing risk of disease in their environment compared to the control slideshows, but the three primes did not elicit differing levels of uncertainty, hopelessness, or disgust.

Desire for sexual variety. To measure women's desire for sexual variety, women were asked to estimate the number of sexual partners that they would ideally like to have over the next: (a) 1 month, (b) 6 months, (c) 1 year, and (d) 5 years (Buss & Schmitt, 1993).

Vulnerability to disease. We measured women's vulnerability to illness and disease using the seven-item perceived infectability subscale from the perceived vulnerability to disease scale (PVD; Duncan, Schaller, & Park, 2009). The perceived infectability subscale prompts participants to indicate their agreement with seven statements that assess their personal susceptibility to illness and disease (e.g., "I have a history of susceptibility to infectious diseases"). All ratings were made on 7-point rating scales (endpoints: 1 = *strongly disagree*, 7 = *strongly agree*). We chose this subscale as our index of disease vulnerability because it is a well-established, validated measure of individual differences in perceived susceptibility to infection and disease (Duncan & Schaller, 2009; Neuberg, Kenrick, & Schaller, 2011; Park, Faulkner, & Schaller, 2003; Schaller & Park, 2011).

Results

We first created a measure of participants' personal vulnerability to illness and disease by creating a mean composite of ratings on the perceived infectability subscale. Appropriate items were reverse

[1] Research materials available upon request.

scored, and higher scores indicated greater perceived vulnerability to infection and disease ($\alpha = .79$). Next, to ensure that the priming procedure did not influence participants' perceived vulnerability to disease, we conducted a univariate ANOVA with vulnerability to disease as the dependent variable and priming slideshow condition (disease threat vs. economic recession threat vs. academic failure)as the grouping variable. The results did not reveal an effect of priming slideshow condition on participants' reported vulnerability to disease ($p = .09$).[2]

Next, we created a composite measure of women's ideal partner number by standardizing participants' ideal partner number within each time point and then averaging the resulting z scores across the four time points ($\alpha = .94$,; see Table 1 for descriptive statistics).[3] We then used multiple regression to regress participants' ideal partner number on priming condition (dummy coded, with disease threat condition as the reference group) and vulnerability to disease (centered) entered in the first step, and the interaction between these two variables entered in the second step. Results indicated a good model fit for the overall model including both dummy codes, $F(5, 78) = 2.54$, $p = .04$ (see Figure 1). We next proceeded to unpack both the interactions and comparisons between each prime condition below by recoding the dummy reference group to obtain all possible comparisons (see Table 1 for descriptive statistics).

Disease threat versus economic recession threat condition. Results revealed a significant two-way interaction between priming condition and vulnerability to disease on participants' desire for sexual variety, $\beta = -.41$ ($SE = .23$), $t(78) = -2.61$, $p = .01$, semipartial $r^2 = .08$. Simple slopes tests revealed that for women in the disease threat condition, higher vulnerability to disease predicted a greater desire for a variety of partners, $\beta = .54$ ($SE = .17$), $t(78) = 2.99$, $p = .004$, semipartial $r^2 = .10$. No such pattern was found for women in the economic recession threat condition, however ($\beta = -.10$, $p = .55$). We next examined the impact of the disease threat prime on women relatively high (1 *SD* above the mean) and low (1 *SD* below the mean) in vulnerability to disease. The disease threat prime led women high in vulnerability to disease to desire a greater variety of partners relative to similar participants in the economic recession threat condition, $\beta = -.40$ ($SE = .32$), $t(78) = -2.36$, $p = .02$, semipartial $r^2 = .06$. We did not observe a priming effect for those low in vulnerability to disease, however ($\beta = .22$, $p = .23$).

Disease threat versus academic failure threat condition. As in our prior analysis, results revealed a significant interaction between priming condition and vulnerability to disease on participants' ideal number of sex partners, $\beta = -.37$ ($SE = .28$), $t(78) = -2.79$, $p = .007$, semipartial $r^2 = .09$. Simple slopes tests revealed that for women in the disease threat condition, higher vulnerability to disease predicted a desire for a greater number of partners, $\beta = .54$ ($SE = .17$), $t(78) = 2.99$, $p = .004$, semipartial $r^2 = .10$. No such pattern was found for women in the academic failure condition ($\beta = -.29$, $p = .22$). We next examined the impact of the disease threat prime on women relatively high (1 *SD* above the mean) and low (1 *SD* below the mean) in vulnerability to disease. The disease threat prime led women high in vulnerability to disease to desire a greater number of sexual partners relative to similar participants in the academic failure condition, $\beta = -.39$ ($SE = .35$), $t(78) = -2.19$, $p = .03$, semipartial $r^2 = .05$. We did not observe a priming effect for those low in vulnerability to disease ($\beta = .39$, $p = .06$), although it was marginally trending toward significance.

Economic recession threat versus academic failure threat condition. We last examined whether there was a difference in ideal partner number between the two control conditions. We recoded the dummy-coded variables such that academic failure was coded as the reference group. We did not find a significant interaction between priming condition and vulnerability to disease on participants' desire for sexual variety, ($\beta = .16$, $p = .89$). Further, we did not observe a priming effect for those low (1 *SD* below the mean) or high (1 *SD* above the mean) in vulnerability to disease between the two control conditions ($ps \geq .30$).

Discussion

Experiment 1 found that the perceived pathogen load has an impact on women's desire for sexual variety. Specifically, we found that for women who reported having the greatest vulnerability to infection and disease, primed cues suggesting a growing disease threat increased the number of sexual partners that they preferred to have compared to women who were primed with cues of resource scarcity or risk of academic failure. This result is consistent with the hypothesis that women will favor mating strategies that promote genetic variability among their offspring in the face of a growing disease threat. Importantly, these effects emerged whether women in the disease threat condition were being compared with women primed with cues to academic stress or those primed with cues to economic uncertainty. These effects suggest that the demonstrated shift in women's sexual decision-making is due to changes in women's beliefs about the growing threat of disease, specifically, and does not occur in response to other forms of ecological stress (e.g., resource scarcity) or stress, more generally (academic failure).[4] This pattern of results is consistent with the diversified genetic bet-hedging hypothesis, demonstrating that women who are most vulnerable to the threat posed by infection and disease respond to cues of such threat by exhibiting psychological shifts that would help promote genetic diversity among their offspring.

Experiment 2: Effects of Disease Vulnerability on Women's Desire for Sexual Variety

Experiment 2 was designed to build on the results of Experiment 1 by examining whether cues indicating a growing threat of disease in

[2] There was one item on this measure that was significantly affected by the prime ($p = .01$). We removed this item and created a new composite measure of perceived vulnerability to disease. Scores on this new measure were not significantly different between conditions ($p = .25$). Next, we conducted our multiple regression analyses using the new composite score as our moderator. This analysis was similar in form to the one reported in the main text and the results were nearly identical. Nearly identical results were also obtained when this analyses was repeated using the unstandardized composite score as the dependent measure.

[3] We also conducted the multiple regression analysis using an unstandardized composite measure of women's desired partner number. The results were nearly identical to those which used the standardized dependent measure.

[4] Although it is possible that cues to resource scarcity may increase women's desire for sexual variety in some conditions (e.g., women with lack of access of resources may seek additional mating opportunities to increase resource success), the current experiment did not find evidence for greater variety seeking among women in the resource scarcity condition.

Table 1
Descriptive Statistics (Study 1)

	Disease threat			Economic uncertainty			Academic failure		
	M	*SD*	Range	*M*	*SD*	Range	*M*	*SD*	Range
Vulnerability to disease	3.44	1.07	1.71–5.71	2.86	1.04	1.14–5.14	3.05	0.77	1.43–4.43
Desired partners 1 month	1.68	0.95	1–5	1.42	0.62	1–3	1.50	0.51	1–2
Desired partners 6 months	2.04	1.10	1–5	1.61	1.15	1–6	1.85	1.13	1–6
Desired partners 1 year	2.32	1.15	1–5	1.90	1.58	1–8	2.14	1.46	1–7
Desired partners 5 year	2.92	1.58	1–7	2.52	1.67	1–8	2.71	1.65	1–8
Mean desired partner number	2.24	1.12	1–5.50	1.86	1.20	1–6.25	2.06	1.10	1–5.75

one's environment would influence women's desire for variety, per se, in their choice of dating and sexual partners. We predicted that women who perceive themselves to be vulnerable to infection and disease would respond to an escalating disease threat by prioritizing variety in their choice of dating and sex partners compared with women exposed to a control threat (increasingly stringent academic standards) or women exposed to cues indicating a growing threat of minor, pesky illnesses that—while annoying—would not pose a threat to the survivability of a woman or her offspring lineage. This latter condition was included to test whether women's desire for sexual variety is specific to the type of serious disease threat that favors genetic bet-hedging strategies in other species (e.g., rising rates of deadly disease that pose a long-term threat to survivability), or if it extends to any illness threat (e.g., the common cold), a finding that would detract from the bet-hedging hypothesis. We also included the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) to test whether our results could potentially be accounted for by divergent emotional responses evoked by the experimental manipulations. This alternative explanation is particularly important to address, as previous research has revealed an association between negative feelings of urgency and increased sexual sensation seeking (Deckman & DeWall, 2011), an effect that could translate into a greater desire for partner variety.

Method

Participants. Participants were 133 heterosexual female undergraduates (M_{age} = 18.69 years, *SD* = 1.05; 44 in the disease threat condition, 47 in the minor illness condition, and 42 in the academic failure condition). All students received partial course credit in exchange for their participation.

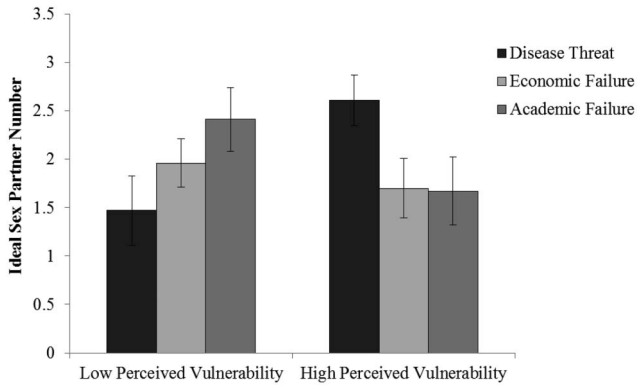

Figure 1. Women's ideal number of sexual partners (plotted using unstandardized means) as a function of priming condition and perceived vulnerability to disease (Experiment 1). Plotted means represent one standard deviation above and below the mean of perceived vulnerability to disease. Error bars reflect the standard error of the mean.

Procedure and materials. The procedure for Experiment 2 was similar to the procedure used in Experiment 1. Participants completed the study in the same testing room and under the same memory testing ruse. Participants were randomly assigned to view one of three slideshows. Two of the slideshows were the same as those used in Experiment 1 (the serious disease threat slideshow and the academic failure slideshow). The third slideshow was similar in form to the others, but depicted a news story about the rising incidence of minor, pesky illnesses. As in Experiment 1, participants viewed each slide in their assigned slideshow for 15 s. After viewing their assigned slideshow, participants answered manipulation check questions (e.g., "How pleasant was the slideshow that you watched?") and a series of questions assessing their desire for variety in their sexual and dating partners. The experiment ended with participants filling out a short battery of demographic questions, as well as a measure of their perceived vulnerability to disease.

Minor illness prime. Participants in the minor illness condition viewed a photo slideshow that ostensibly summarized a recent news story from *Newsweek* magazine.[5] The slideshow was titled, "*Tis' the Season for Pesky Illnesses: Minor Health Woes on the Rise.*" This slideshow included captioned photos that told a story about minor health woes—such as the common cold, pink eye, and head lice—being at their peak for the season. The news story highlighted that, although these irritating maladies decrease workplace productivity and pose a major inconvenience, they do not pose a threat to long-term health.

Desire for sexual variety. To measure women's desire for sexual variety, women were asked to fill out a 2-block, 11-item measure of variety seeking that was comprised of modified variety-seeking questions from the Brief Sexual Attitudes Scale (BSAS; Hendrick, Hendrick, & Reich, 2006) and Sexual Sensation Seeking scale (SSS; Kalichman & Rompa, 1995). These items were chosen and modified based on the objective of directly measuring women's desire for sexual variety-seeking, per se, and included the following questions: (a) I would like to have sex with a variety of different types of men in my lifetime, (b) I could imagine myself getting bored if I only dated one type of man my whole life, (c) I would like to have several different relationships with a variety of men in my lifetime, (d) When it comes to sex, variety is the spice of life, (e) I cannot imagine only being sexually attracted to one type of person, (f) I like dating different types of men, (g) I would like to experience relationships

[5] Research materials available upon request.

with several different types of men, (h) I am attracted to multiple types of men, (i) I like to have new and exciting sexual experiences with different partners, (j) I desire variety in my sexual partners, and (k) I desire variety in my dating partners ($\alpha = .89$).

Vulnerability to disease. Similar to Experiment 1, we measured women's vulnerability to illness and disease using the seven-item perceived infectability subscale from the PVD (Duncan et al., 2009). Participants' vulnerability to disease was measured by reverse scoring appropriate items (higher scores indicating greater vulnerability to diseases) and creating a mean composite of these questions ($\alpha = .90$).

Results

See Table 2 for descriptive statistics. To confirm that the priming procedure did not influence participants' perceived vulnerability to disease, we conducted a univariate ANOVA with the vulnerability to disease composite as the dependent variable and priming condition (disease risk vs. minor illness vs. academic failure) as the grouping variable. The results revealed that there was no effect of priming condition on participants' reported vulnerability to disease ($p = .64$).

Because the anchor points of the SSS and the BSAS differ (SSS: 1 = *not at all like me*, 4 = *very much like me*; BSAS: 1 = *strongly disagree*, 5 = *strongly agree*), women's answers from the two separate blocks of questions were standardized using *z*-scores and combined into a mean score composite of sexual variety seeking, with higher scores indicating greater desire for sexual variety ($\alpha = .89$). Next, we examined whether priming condition or the interaction between priming condition and perceived vulnerability to disease produced significant changes in affect. To test this, we computed separate composites from the PANAS to obtain measures of positive ($\alpha = .90$) and negative ($\alpha = .86$) affect. We then used multiple regression models with priming condition (dummy-coded) and perceived vulnerability to disease (centered) as predictors in the first step, and the interaction between these two variables in the second step, with each measure of affect entered as the dependent variable. The results of these analyses revealed that there was not a main effect of priming condition nor an interaction between priming condition and childhood illness on either positive ($ps \geq .16$) or negative ($ps \geq .41$) affect scores. Next, we used multiple regression to regress participants' desired sexual variety on priming condition (dummy coded, with disease threat condition coded as the reference group) and vulnerability to disease (centered) entered in the first step, and the interaction between these two variables entered in the second step. Results indicated a good model fit for the overall model including both dummy codes, $F(5, 127) = 3.01$, $p = .01$ (see Figure 2).

Table 2
Descriptive Statistics (Experiment 2)

	Disease threat		Minor illness		Academic failure	
	M	*SD*	*M*	*SD*	*M*	*SD*
Positive affect	2.29	0.91	2.34	0.73	2.27	0.88
Negative affect	1.58	0.58	1.45	0.56	1.61	0.64
Vulnerability to disease	3.57	1.31	3.41	1.32	3.68	1.47
Desire for sexual variety	0.22	0.77	−0.01	0.68	−0.17	0.58

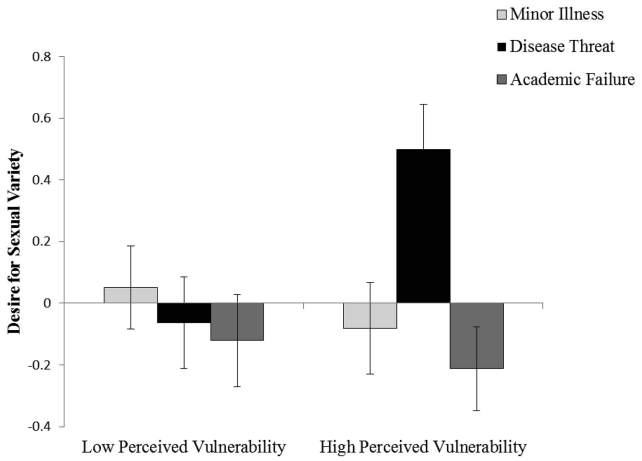

Figure 2. Women's desire for sexual variety as a function of priming condition and perceived vulnerability to disease (Experiment 2). Plotted means represent one standard deviation above and below the mean of perceived vulnerability. Error bars reflect the standard error of the mean.

Therefore, we proceeded by unpacking both the interactions and comparisons between each prime condition below (see Table 2).

Disease threat versus minor illness condition. Results revealed a significant two-way interaction between priming condition and vulnerability to disease on participants' desire for sexual variety, $\beta = -.29$ ($SE = .11$), $t(127) = -2.35$, $p = .02$, semipartial $r^2 = .04$. Simple slopes tests revealed that for women in the disease threat condition, higher vulnerability to disease predicted a greater desire for a variety of partners, $\beta = .40$ ($SE = .08$), $t(127) = 2.64$, $p = .009$, semipartial $r^2 = .05$. No such pattern was found for women in the minor illness condition, however ($\beta = -.09$, $p = .52$). We next examined the impact of the disease threat prime on women relatively high (1 *SD* above the mean) and low (1 *SD* below the mean) in vulnerability to disease. The disease threat prime led women high in vulnerability to disease to desire a greater variety of partners relative to similar participants in the minor illness condition, $\beta = -.40$ ($SE = .21$), $t(127) = -2.78$, $p = .006$, semipartial $r^2 = .05$. We did not observe a priming effect for those low in vulnerability to disease, however ($\beta = .12$, $p = .39$).

Disease threat versus academic failure condition. Results comparing the disease condition to the academic failure condition revealed a significant two way interaction between priming condition and vulnerability to disease on participants' desire for sexual variety, $\beta = -.28$ ($SE = .11$), $t(127) = -2.26$, $p = .03$, semipartial $r^2 = .04$. Simple slopes revealed that for women in the disease threat condition, higher vulnerability to disease predicted a greater desire for a variety of partners, $\beta = .40$ ($SE = .08$), $t(127) = 2.64$, $p = .009$, semipartial $r^2 = .05$. No such pattern was found for women in the academic failure condition, however ($\beta = -.07$, $p = .64$). We next examined the impact of the disease threat prime on women relatively high (1 *SD* above the mean) and low (1 *SD* below the mean) in vulnerability to disease. Women high in vulnerability to disease desired a greater variety of sexual partners relative to similar participants in the academic failure condition, $\beta = -.48$ ($SE = .20$), $t(127) = -3.57$, $p = .001$, semipartial $r^2 = .09$. We did not observe a priming effect for those low in vulnerability to disease ($\beta = .04$, $p = .78$).

Minor illness versus academic failure condition. Lastly we examined whether there was a difference between the two control conditions. To this end, we used another set of dummy-coded variables in which academic failure was the reference group. In this case, there was not a significant interaction between priming condition and vulnerability to disease on participants' desire for sexual variety, ($\beta = -.02$, $p = .89$). Further, we did not observe a priming effect for those low (1 *SD* below the mean) or high (1 *SD* above the mean) in vulnerability to disease between the two control conditions ($ps \geq .39$).

Discussion

The results of Experiment 2 found continued support for the genetic bet-hedging hypothesis. Specifically, the results of this experiment found that women high in perceived infectability responded to cues of growing disease threat in their environment by exhibiting a greater desire for variety, per se, in their choice of dating and sexual partners. Importantly, this difference was found whether the women in the disease threat condition were being compared with women who were primed with cues indicating a growing risk of academic failure or women primed with cues indicating a rising incidence of minor illnesses. This latter comparison provides evidence that the exhibited shift in women's mating psychology only occurs in response to grave illness/disease cues, which have the potential to impact the survivability of a woman's offspring lineage. In the case of minor illnesses—which challenge the immune system, but do not pose a survival threat to a woman or her descendants—the benefits of having genetically diverse offspring would not be worth the substantial costs associated with pursuing a multiple male mating strategy. Together, these results lend support for the hypothesis that vulnerability to illnesses and disease increase women's desire for mating strategies that emphasize partner variety.

Experiment 3: Effect of Disease Vulnerability on Women's Desire for Novel Dating Partners

Experiments 1 and 2 measured women's desire for sexual variety by asking women questions about the number of sexual partners they would like to have in the future (Experiment 1) and their desire for diversity, per se, in their choice of partners (Experiment 2). Experiment 3 was designed to conceptually replicate and extend these results using a behavioral choice measure. Specifically, we measured the number of novel male partners that women chose in a hypothetical dating scenario. We predicted that women highly vulnerable to disease would respond to disease threat cues by choosing a greater number of novel dating partners compared with comparable women in the control condition.

Method

Participants. Participants were 71 heterosexual, female undergraduates ($M_{age} = 18.52$ years, $SD = .79$; 36 in the disease threat condition). Participants received partial course credit in exchange for their participation.

Procedure and materials. As in Experiments 1 and 2, participants viewed a slideshow about the growing threat of pathogens and disease in their environment or a control slideshow about academic failure. After completing the priming procedure, participants were presented with a hypothetical dating scenario designed to measure their desire for partner variety.[6] Specifically, participants were given the following instructions:

> Imagine that you will go on a date twice a week for 1 month. We would like to know which men you'd like to see on your dates. You can choose the same man for every date or choose a new man for each date. It's up to you! For each day, please write the number that corresponds to the man that you would like to date.

Following this instruction set, participants viewed a list of 10 men's names, followed by a brief description of each male target (e.g., Jason: accounting major, vice president of his fraternity; John: has a dog, volunteers at a local animal shelter). Below this list were eight text boxes labeled "Date 1,", "Date 2," and so on through "Date 8," where participants were asked to write the name(s) of the male target(s) that they would like to choose for each date. Participants were next asked to complete the PANAS, a series of demographic questions (e.g., age, sexual orientation), and the perceived infectability subscale of the PVD.

Results

First, to ensure that the priming procedure did not impact participants' perceptions of their vulnerability to illnesses and disease, we conducted a univariate ANOVA with condition as the predictor and perceived infectability scores as the dependent measure. Results indicated that priming condition did not influence participants' perceived vulnerability to infection and disease, $p = .97$. Next, we computed participants' scores on the PANAS to obtain indices of positive ($\alpha = .89$) and negative ($\alpha = .74$) affect. These scores were analyzed separately using multiple regression models that included priming condition and perceived infectability as predictors in the first step, and the interaction between these two variables in the second step. The results of the first analysis revealed no significant main effects of either of our predictors on positive affect ($ps \geq .14$), nor did we find evidence for an interaction between these two variables on this measure ($p = .13$). Our second model revealed no main effect of perceived infectability ($p = .20$), or an interaction between priming condition and perceived infectability ($p = .70$), on negative affect. However, the analysis did reveal a main effect indicating that participants in the disease threat condition reported significantly more negative affect than participants in the academic failure condition ($M_{disease} = 1.59$, $SD = .46$; $M_{failure} = 1.35$, $SD = .35$); $\beta = -.24$ ($SE = .10$), $t(67) = -2.09$, $p = .04$, semipartial $r^2 = .06$. We therefore included negative affect as a covariate in our main statistical model to control for any differences in women's desire for partner variety that could be attributed to differences in negative affect.

Next, we counted the number of novel partners that women chose for their hypothetical dates and entered this score as the dependent measure in our multiple regression model (see Table 3 for descriptive statistics). As in our prior analysis, condition (dummy-coded) and vulnerability to disease (centered) were entered as predictors in the first step, with the interaction between these variables entered into the second step. Participants' negative affect scores were also entered into the first step to control for any effect that the reported differences in negative affect may have on our dependent measure. Results revealed a marginally significant

[6] Research materials available upon request.

Table 3
Descriptive Statistics (Experiment 3)

	Disease threat		Academic failure	
	M	*SD*	*M*	*SD*
Positive affect	2.18	0.69	2.25	0.83
Negative affect	1.59	0.46	1.38	0.37
Vulnerability to disease	3.63	1.40	3.64	1.47
Date partner number	5.39	2.12	4.71	1.76

interaction between priming condition and vulnerability to disease on participants' chosen number of novel dating partners, $\beta = -.32$ ($SE = .32$), $t(66) = -1.91$, $p = .06$, semipartial $r^2 = .05$. Simple slopes tests revealed that for women in the disease threat condition, higher vulnerability to disease predicted a desire for a greater number of partners, $\beta = .37$ ($SE = .23$), $t(66) = 2.17$, $p = .03$, semipartial $r^2 = .06$. No such pattern was found for women in the control condition ($p = .63$). Additionally, we examined the impact of the disease threat prime on women relatively high and low in vulnerability to disease (1 *SD* above and below the mean, respectively). The disease threat prime led women high in disease vulnerability to choose a greater number of novel hypothetical dating partners compared to participants in the control condition, $\beta = -.43$ ($SE = .66$), $t(66) = -2.55$, $p = .01$, semipartial $r^2 = .09$ (see Figure 3). We did not observe a priming effect for those low in vulnerability to disease ($\beta = .02$, $p = .91$).

Discussion

The results of our third experiment provided additional support for the hypothesis that women's mating psychology may be functionally attuned to changes in disease risk. Specifically, Experiment 3 revealed that women who feel most vulnerable to the threat of infection and disease respond to cues of a growing disease threat by desiring a greater number of novel dating partners. Taken together with Experiments 1 and 2, these results lend support for the hypothesis that women may shift their mating strategies in ways that promote genetically diverse offspring in response to cues indicating an escalating disease threat in their environment.

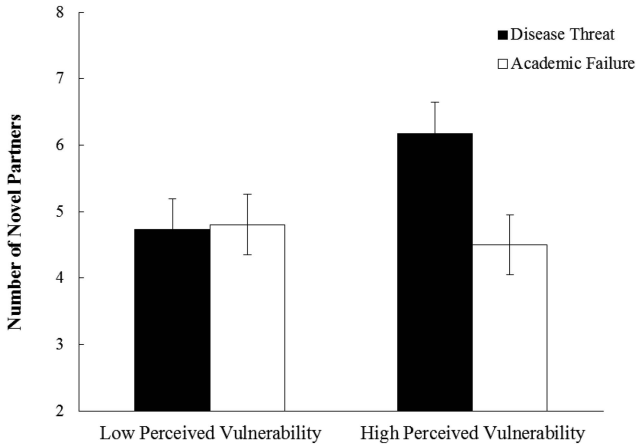

Figure 3. Women's chosen number of novel dating partners as a function of priming condition and perceived vulnerability to disease (Experiment 3). Values reflect adjusted values at one standard deviation above and below the mean of perceived vulnerability to disease. Error bars reflect the standard error of the adjusted means.

Experiment 4: Is the Impact of Perceived Vulnerability to Disease on the Desire for Partner Variety Specific to Women?

Experiment 3 demonstrated that primed disease threat cues led women who are most vulnerable to disease to choose a wider variety of dating partners than were chosen by comparable women in the control group. Experiment 4 was designed to examine whether this increase is specific to women, or if disease vulnerability has a similar impact on men. Both men and women—particularly those with a history of vulnerability to illness—would stand to benefit from increased genetic diversity among offspring in conditions of heightened disease risk. However, men's mating psychology may be less sensitive to such cues, as the potential fitness benefits associated with mating with a variety of women are typically sufficiently high—even in conditions of low disease threat—to make the marginal returns associated with an increased desire for novelty in high disease risk environments relatively low (see, e.g., Buss & Schmitt, 1993; Schmitt et al., 2001). Indeed, research on nonhuman animals—even those with relatively high levels of paternal investment—finds that sexual variety seeking in response to disease threat is exhibited only by females of the species (see, e.g., Foerster, Delhey, Johnsen, Lifjeld, & Kempenaers, 2003; Petrie & Kempenaers, 1998). Accordingly, we included men in Experiment 4 to test whether the demonstrated disease risk-sensitive increase in the desire for sexual variety is an effect that is uniquely characteristic of women's mating psychology or whether it generalizes to men.

Method

Participants. Participants were 153 heterosexual undergraduates (89 female; $M_{age} = 18.78$ years, $SD = 1.37$; 79 in the disease threat condition). Participants received partial course credit in exchange for their participation.

Procedure and materials. The priming procedure was the same as in Experiments 1 through 3. As in Experiment 3, participants were told that they would be going on two dates per week over the course of the next month and that they could choose as few or as many different partners for these dates as they would like. The descriptions of the available dating partners were identical for men and women except for the names used (men viewed women's names and women viewed men's names). Participants then completed the PANAS and the perceived infectability subscale of the PVD scale. Finally, they were thanked, debriefed, and dismissed.

Results

First, to ensure that participants did not differ across conditions in perceived vulnerability to disease, we conducted a univariate ANOVA with condition as the predictor and perceived infectability scores as the dependent measure. Unexpectedly, results indicated that participants in the disease risk condition scored higher

on our measure of perceived infectability than those in the control condition ($M_{disease}$ = 3.30, SD = 1.12; $M_{academic}$ = 2.89, SD = 1.07); $F(1, 151) = 5.33$, $p = .02$, $d = .39$. Because the two groups differed in their perceived vulnerability to disease, we centered this variable separately within each testing condition. We did this so that we could make comparisons between the two groups among those who are relatively high and relatively low in perceived vulnerability within each condition.[7]

Next, we computed participants' scores on the PANAS in order to obtain indices of positive ($\alpha = .91$) and negative ($\alpha = .81$) affect. These scores were analyzed separately using multiple regression models that included priming condition and perceived infectability as predictors in the first step, and the interaction between these two variables in the second step. The results of our first analysis revealed no main effect of priming condition on negative affect ($p = .75$), nor an interaction between priming condition and perceived infectability ($p = .61$) on this measure. Similarly, the results of the second analysis revealed no interaction between condition and perceived infectability on positive affect ($p = .28$). However, we did find a main effect of priming condition such that participants in the disease threat condition reported significantly less positive affect than did participants in the academic failure condition ($M_{disease}$ = 2.37, SD = .79; $M_{failure}$ = 2.68, SD = .94); $\beta = .17$ (SE = .14), $t(149) = 2.13$, $p = .04$, semipartial $r^2 = .03$. We therefore controlled for positive affect in our main statistical model.

Next, as in Experiment 3, we counted the number of different partners that participants chose for their hypothetical dates and entered this score as the dependent variable in our multiple regression model (see Table 4 for descriptive statistics). Participant sex, condition, and vulnerability to disease (centered within condition) were entered as predictors in the first step, with the two-way interactions between these variables entered into the second step, and the three-way interaction between these variables entered into the third step. Participants' positive affect scores were also entered into the first step to control for any effect that differences in positive affect may have on our dependent measure. Results of this analysis revealed a marginally significant three-way interaction between sex, priming condition, and vulnerability to disease on participants' desired number of novel dating partners, $\beta = .27$ (SE = .59), $t(143) = 1.88$, $p = .06$, semipartial $r^2 = .02$. We probed this interaction by recoding the dummy variable for gender and examining the impact of priming condition and perceived vulnerability to disease on participants' desired number of novel partners separately for each sex while maintaining the full sample in the model.

For men, the results of our follow-up analysis revealed no main effects of priming condition or vulnerability to disease on their chosen number of novel dating partners ($ps \geq .13$) nor an interaction between these two variables ($p = .61$). For women, however, this analysis revealed a significant interaction between priming condition and vulnerability to disease, $\beta = -.33$ (SE = .35), $t(143) = -2.48$, $p = .01$, semipartial $r^2 = .03$ Simple slopes tests found that for women in the disease threat condition, higher vulnerability to disease was predictive of a trending desire for a greater number of dating partners, $\beta = .21$ (SE = .22), $t(143) = 1.69$, $p = .09$, semipartial $r^2 = .02$. However, this result was not statistically significant. For those in the control condition, higher vulnerability to disease was marginally predictive of a desire for fewer dating partners, $\beta = -.27$ (SE = .27), $t(143) = -1.81$, $p = .07$, semipartial $r^2 = .02$ (see Figure 4). Again, we examined the impact of the disease threat prime on women relatively high (1 SD above the mean) and low (1 SD below the mean) in vulnerability to disease. The disease threat prime led women high in perceived vulnerability to choose a greater number of novel hypothetical dating partners compared to participants in the control condition, $\beta = -.27$ (SE = .52), $t(143) = -2.03$, $p = .05$, semipartial $r^2 = .02$ (see Figure 4). We did not observe a priming effect, however, for those low in vulnerability to disease ($\beta = .22$, $p = .16$).

Table 4
Descriptive Statistics (Experiment 4)

	Disease threat		Academic failure	
	M	*SD*	*M*	*SD*
Positive affect				
Men	2.63	0.82	2.49	1.02
Women	2.18	0.72	2.80	0.88
Negative affect				
Men	1.49	0.43	1.46	0.47
Women	1.49	0.47	1.56	0.62
Vulnerability to disease				
Men	3.08	0.90	2.58	1.08
Women	3.47	1.25	3.09	1.03
Date partner number				
Men	5.00	2.06	4.17	2.06
Women	5.95	1.66	5.91	1.79

Discussion

The results of Experiment 4 conceptually replicated the results of Experiment 3, demonstrating that women who have a history of vulnerability to illness and infection respond to cues indicating an escalating disease threat by desiring a greater number of novel dating partners. Further, the results of Experiment 4 found evidence that this shift is characteristic of women's—but not men's—mating psychology. These findings are consistent with research on nonhuman animals (e.g., Sherman, Seeley, & Reeve, 1988) and also with research on sex differences in the potential reproductive benefits available from seeking partner variety in nondisease threat conditions (e.g., Buss & Schmitt, 1993; Schmitt et al., 2001; Symons, 1979; Trivers, 1972).

An unanticipated result from Experiment 4 was that there was a main effect of priming condition on participants' perceived infectability scores, with participants in the disease threat condition scoring higher on this measure than those in the control group. Although this is a trait measure comprised primarily of retrospective items (e.g., "I have a history of susceptibility to infectious disease"), it also includes prospective items (e.g., "If an illness is going around, I will get it"), making it possible that the disease risk prime led participants to feel more vulnerable to diseases. Importantly, the results of this study revealed a pattern of results nearly identical to those found in our first three experiments and this

[7] We also conducted the multiple regression analyses with scores on the perceived infectability subscale of the PVD (PVD-PI) centered across conditions. The analyses revealed results nearly identical to those obtained when perceived infectability was centered within conditions.

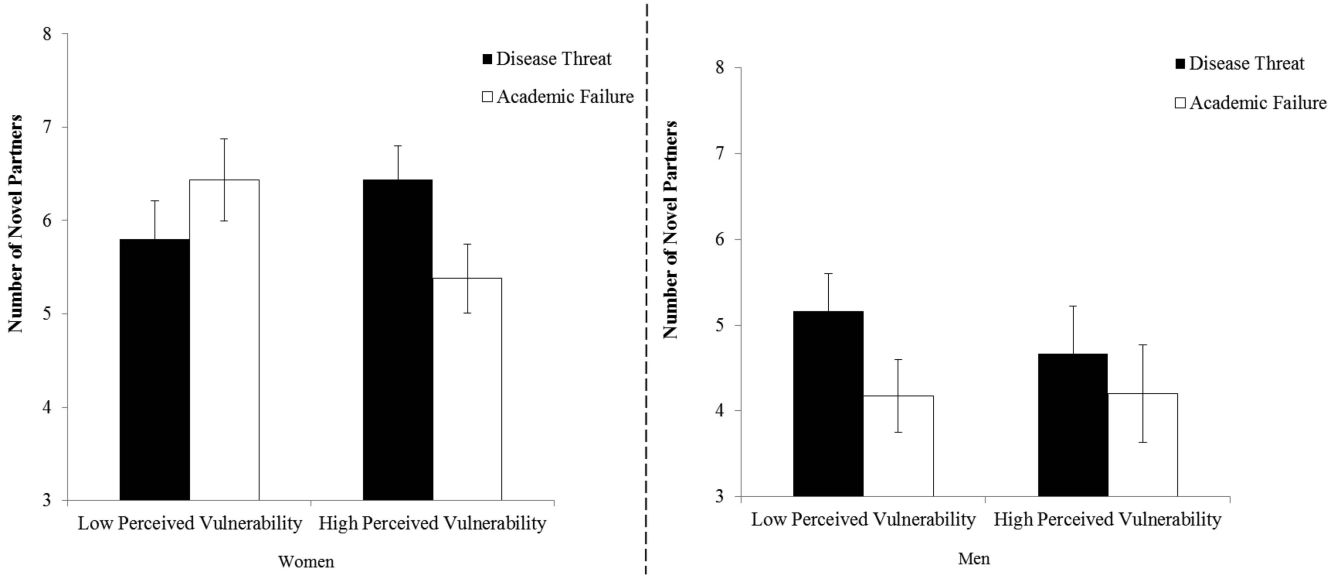

Figure 4. Men and women's preferred number of novel dating partners as a function of priming condition (disease threat vs. academic failure) and perceived vulnerability to disease (Experiment 4). Plotted means are adjusted and represent one standard deviation above and below the mean of perceived vulnerability to disease. Error bars reflect the standard error of the adjusted means.

pattern persisted even after removing items that were sensitive to the priming manipulation.[8] Together, these results are consistent with the hypothesis that cues of a growing disease threat lead disease-vulnerable women to shift their mating strategies in ways that promote a diversified genetic bet-hedging strategy.

Experiment 5: Is the Impact of Perceived Vulnerability to Disease on Desire for Partner Variety Specific to the Mating Domain?

Experiment 5 was designed to extend the results of Experiments 1 through 4 in three key ways. First, we sought to examine whether we could conceptually replicate the pattern of results found in the previous four experiments using a novel measure of vulnerability to disease: history of childhood illness. Because immune function is calibrated early in development (McDade, 2003; West, 2002), one's history of illness in childhood is highly predictive of one's vulnerability to diseases in adulthood and of one's overall adulthood immunocompetence (Barker et al., 1991; Barker & Osmond, 1986; McDade, 2005). Further, because one's history of childhood illness is an exclusively retrospective measure, it is also less likely to be influenced by the priming procedure than the perceived infectability subscale of the PVD. Thus, the first aim of Experiment 5 was to examine whether we could conceptually replicate the observed pattern of results using this novel measure of vulnerability to infection and disease.

The second goal of Experiment 5 was to examine whether the pattern of results found in Experiments 1 through 4 would persist when women are choosing dating partners based on photographs rather than text-based descriptions. Previous research finds that increased infection risk increases the importance that women place on phenotypic markers of good health (Gangestad & Buss, 1993; Lee & Zietsch, 2011; Little, DeBruine, & Jones, 2011). Because Experiments 3 and 4 did not provide any information about cues bearing on the health of the hypothetical dating partners (e.g., their physical attractiveness), it is possible that women chose a greater number of novel men as a means of increasing their chances of choosing one healthy partner, rather than reflecting a shift favoring variety seeking, per se. Experiment 5 was therefore designed to test whether our results would persist when women were choosing among men who were all shown to be high in attractiveness and perceived health. Lastly, we sought to examine whether women's desire for variety is specific to dating partners—as predicted by the genetic bet-hedging hypothesis—or whether it is a byproduct of a more general increase in variety seeking across domains. To this end, we added a second measure of women's desire for variety—the desire for variety in shades of nail polish that women could choose to wear over the course of 8 weeks. We predicted that women with a heightened vulnerability to disease—as indexed by having an extensive history of childhood illness—would report desiring a greater number of novel dating partners in response to cues indicating a heightened disease threat in the environment. We further predicted that this effect would be specific to women's desire for dating partners and

[8] An unanticipated result from Experiment 4 was that there was a main effect of priming condition on participants' perceived infectability scores, with participants in the disease threat condition scoring higher on this measure than those in the control group. Similar to Experiment 1, we removed the items that were significantly affected by the prime from our individual difference measure and conducting our multiple regression analyses using this new composite as our moderator. These results were nearly identical to those reported in the article.

would not carry over to an increased desire for variety in nail polish color.

Method

Participants. Participants were 55 heterosexual female undergraduates (M_{age} = 19.58 years, SD = 1.21; 27 in the disease threat condition). All students received partial course credit in exchange for their participation.

Procedure and materials. The priming procedure was the same as that used in our previous experiments. After completing the priming procedure (disease threat vs. academic failure), participants were presented with a hypothetical dating scenario similar to that used in Experiments 3 and 4. Participants were asked to imagine that they would be going on a date twice a week for 1 month and to choose the men (or man) with whom they would like to go on these dates. Below the instruction set, there were numbered head and shoulders photographs of 10 phenotypically diverse men.[9] Because previous research has found that disease threat cues can increase women's desire for physically attractive, masculine partners (Gangestad & Buss, 1993; Lee & Zietsch, 2011; Little et al., 2011), the men in the photographs were all physically attractive, but varied in their hair color, eye color, and racial background.

Participants were instructed to type the number corresponding to the man they would choose for each of their eight dates in text boxes (labeled "Date 1," "Date 2," and so on through "Date 8"). Participants were also asked to complete a similar task, where they imagined they would wear nail polish for the next eight weeks.[10] Participants were instructed to indicate which colors (picked from a matrix of colors located below the instruction set) they would wear each week by typing the number in labeled text boxes ("Week 1," "Week 2,". . . "Week 8"). The order of these tasks was randomized via Qualtrics software. Participants were next asked to complete the PANAS and a series of demographic questions (e.g., age, sexual orientation). Lastly, participants were asked to rate their agreement with the following three statements to measure their history of illness: (a) "I was somewhat sickly as a child;" (b) "When I was growing up, I missed a lot of school due to illness;" and (c) "I remember being sick a lot when I was a kid;" (α = .94). Ratings were made on 7-point scales with higher values indicating greater agreement (and a greater history of childhood illness).

Target photographs. Previous research suggests that exposure to pathogen threats increases women's desire for mates who display indicators of good health (Welling, Conway, DeBruine, & Jones, 2007). In light of these results, we selected photographs of 10 male targets who would be perceived as being both high in physical attractiveness (an indicator of health and developmental stability; e.g., Gangestad & Buss, 1993; Little et al., 2011) and healthiness. To ensure that the chosen targets met these criteria, an independent sample of 38 female undergraduate students (M_{age} = 20.63 years, SD_{age} = 1.82) rated all targets regarding their physical attractiveness and perceived health. These items were presented on 10-point scales, with higher values corresponding to greater attractiveness or perceived health. Composite scores were created by averaging together the attractiveness and health ratings made for each of the 10 target photographs (physical attractiveness: α = .87; perceived health: α = .88). We conducted two-tailed t tests to verify that the selected targets were perceived to be more attractive and healthier than "average" (in other words, rater higher than the midpoint on our 10-point scale). Analyses indicated that the targets were rated as significantly more attractive than average (M = 7.43, SD = 1.33), $t(37)$ = 11.26, $p < .001$. Further, the targets were perceived to be significantly healthier than average (M = 7.55, SD = 1.20), $t(37)$ = 13.13, $p < .001$.

Results

First, to ensure that participants' history of childhood illness did not differ between conditions, we conducted a univariate ANOVA with condition as the predictor and participants' childhood illness scores as the dependent measure. Results indicated that the two groups did not differ, p = .40. Next, we computed participants' scores on the PANAS in order to obtain indices of positive (α = .93) and negative (α = .88) affect. These scores were analyzed separately using multiple regression models that included priming condition (dummy-coded) and history of childhood illness (centered) as predictors in the first step, and the interaction between these two variables in the second step. The results of these analyses revealed no main effect of priming condition nor an interaction between priming condition and childhood illness on either positive (ps $\geq$ .17) or negative (ps $\geq$ .35) affect scores.

To create our dependent measures, we summed the number of novel partners that women chose for their hypothetical dates and the number of different colors of nail polish that women chose to wear (see Table 5 for descriptive statistics). We used multiple regression to examine the impact of priming condition and childhood illness history on each of these variables. In both of our models, condition (dummy-coded) and childhood illness history (centered) were entered as predictors in the first step, with the interaction between these variables entered into the second step. First, we examined the number of novel dating partners that women chose for their hypothetical dates. Results revealed a significant interaction between priming condition and history of childhood illness on participants' chosen number of novel dating partners, β = −.58 (SE = .38), $t(51)$ = −2.86, p = .006, semipartial r^2 = .13. Simple slopes tests revealed that for women in the disease threat condition, a greater history of disease predicted the desire for a greater number of partners, β = .63 (SE = .29), $t(51)$ = 3.07, p = .003, semipartial r^2 = .15. No such pattern was found for women in the control condition, however (p = .46; see Figure 5). Additionally, the disease threat prime led women with a greater history of childhood illness (1 SD above the mean) to choose a greater number of novel hypothetical dating partners compared to participants in the control condition, β = −.56 (SE = .73), $t(51)$ = −2.93, p = .005, semipartial r^2 = .14 (see Figure 5). We did not observe a priming effect for those with relatively less childhood illness (1 SD below the mean), β = .23, p = .23.

Next, we examined the impact of condition and childhood illness history on participants' desire for variety in a nonmating domain: nail polish colors. Results of this analysis revealed no main effects of condition (β = .07, p = .61) or childhood illness history (β = .20, p = .16) on desire for variety in nail polish colors, nor did we find an interaction between these variables (β = −.01, p = .96).

[9] Research materials available upon request.
[10] Research materials available upon request.

Table 5
Descriptive Statistics (Experiment 5)

	Disease threat		Academic failure	
	M	*SD*	*M*	*SD*
Positive affect	2.12	0.89	2.25	0.85
Negative affect	1.35	0.51	1.46	0.53
Childhood illness	1.84	1.19	2.14	1.46
Date partner number	4.30	2.07	3.79	1.75
Nail polish number	6.04	2.28	5.82	2.41

Discussion

The results of Experiment 5 conceptually replicated the results of Experiments 1 through 4 using a novel measure of vulnerability to illnesses—participant's history of illness in childhood[11]—and using photographic stimuli. Specifically, Experiment 5 found evidence that disease threat cues led women with a history of illness in childhood to choose a greater number of novel dating partners compared to women in the control condition and compared with women without a history of illness. That women continued to exhibit a desire for partner novelty even when choosing among partners that were all high in attractiveness and perceived health detracts from the possibility that the results of Experiments 3 and 4 reflected a shift wherein women were choosing a greater number of partners as a means of increasing their odds of finding a single high quality mate. Instead, this result—particularly when taken together with the results of Experiments 1 and 2—suggests that disease threat cues lead disease-vulnerable women to desire variety, per se, in their dating and sexual partners.

Experiment 5 also demonstrated that women's increased desire for partner variety in response to disease threat cues is specific to the mating domain and does not translate to a nonmating domain. Despite preferring greater variety in their choice of dating and sexual partners, disease-vulnerable women did not express a greater desire for variety in colors of nail polish that they would choose over a month's time. This result is consistent with the proposed bet-hedging hypothesis and suggests that the impact of disease cues on women's sexual decision-making does not emerge as a byproduct of a more general shift in women's preference for novelty in all choice domains.

General Discussion

From an evolutionary psychological perspective, the adaptive benefits available to men from mating strategies that emphasize partner novelty are relatively well understood. Because men's minimum investment in offspring production is relatively low, men can directly increase their number of descendants merely by gaining sexual access to multiple female partners (Symons, 1979; Trivers, 1972). This same benefit is not available to women, however, raising the question of why females would desire to mate with multiple partners, particularly when it puts them at a greater risk of violence, infection, and loss of male investment. Guided by insights from evolutionary biology and behavioral ecology, the current research examined whether women's desire for sexual variety might be influenced by a factor that biologists have long understood to promote behaviors that increase genetic variability among offspring: the threat posed by infection and disease in one's ecology (Hamilton et al., 1990; Petrie & Kempenaers, 1998; Vrijenhoek, 1993). In addition to slowing the rate at which pathogens themselves evolve, having genetically diverse offspring increases the likelihood that at least one will possess the immune genes necessary to survive into adulthood. Guided by these insights, the present studies tested whether women with a history of vulnerability to illnesses would respond to cues indicating a growing disease threat in their environment by prioritizing variety in their choice of dating and sexual partners.

Across five experiments, we found evidence that the threat of illness and disease may play an important role in shaping women's desire for sexual variety. Specifically, our experiments found that women with a history of vulnerability to illnesses respond to disease threat cues by desiring a greater number of novel sexual and dating partners. Our results replicated across a variety of measures and persisted when using multiple indices of personal vulnerability to illness. Moreover, as predicted from our diversified bet-hedging hypothesis, this pattern of results was found to emerge only in response to disease threats that have the potential to pose a threat to the long-term survivability of a woman and her offspring lineage (Experiments 2) and did not generalize to predict greater variety seeking in a nonsexual domain (Experiment 5). Finally, the effects of disease threat on variety seeking were specific to women and were not demonstrated by men (Experiment 4).

Taken together, our results provide evidence of a novel conceptual link between the threat of morbidity/mortality from disease and women's sexual decision-making. Further, the current results suggest that women may use cues from their environment to forecast the types of conditions likely to be encountered by their offspring and adjust their mating strategies in ways that will promote the survivability of their descendants in these environments. To our knowledge, this is some of the first empirical research to make explicit the role that expectations about future environments (conscious or unconscious) play in shaping mating decisions, making it poised to set the stage for new research into the role that such fitness forecasting plays in shaping a variety of future-oriented decisions, including—but not limited to—proactive strategies aimed at minimizing disease threat (see Schaller, 2014; Stevenson, Case, & Oaten, 2011). Together, this research

[11] In Study 5, we also included the PVD-PI, which was highly correlated with our measure of childhood illnesses, $r = .581$, $p < .001$. We also reran our analyses with PVD-PI as our moderator. The results did not replicate with PVD-PI as our measure of vulnerability to disease threats ($p = .89$). However, it is important to note that the mean PVD-PI score was lower in Experiment 5 ($M_{\text{Experiment5}} = 2.95$) than it was in the other experiments ($M_{\text{Experiments1-4}} = 3.43$). When we reran the analysis looking only at women who scored at or above 3 on the measure of PVD-PI (making the mean comparable to the other four experiments), results replicated the pattern observed in the previous four experiments. Specifically, the results of our analysis revealed a significant interaction between priming condition and vulnerability to disease on participants' chosen number of partners, $\beta = -.61$ ($SE = .82$), $t(20) = -2.12$, $p = .05$. Simple slopes tests revealed that for women in the disease threat condition, higher vulnerability to disease predicted a greater number of chosen partners, $\beta = .81$ ($SE = .62$), $t(20) = 2.77$, $p = .01$. Further, examining the impact of the disease threat prime on women relatively high (1 *SD* above the mean) in vulnerability to disease found that the threat prime led women high in vulnerability to disease to choose a greater number of dating partners relative to similar participants in the control condition, $\beta = -.58$ ($SE = .94$), $t(20) = -2.12$, $p = .05$.

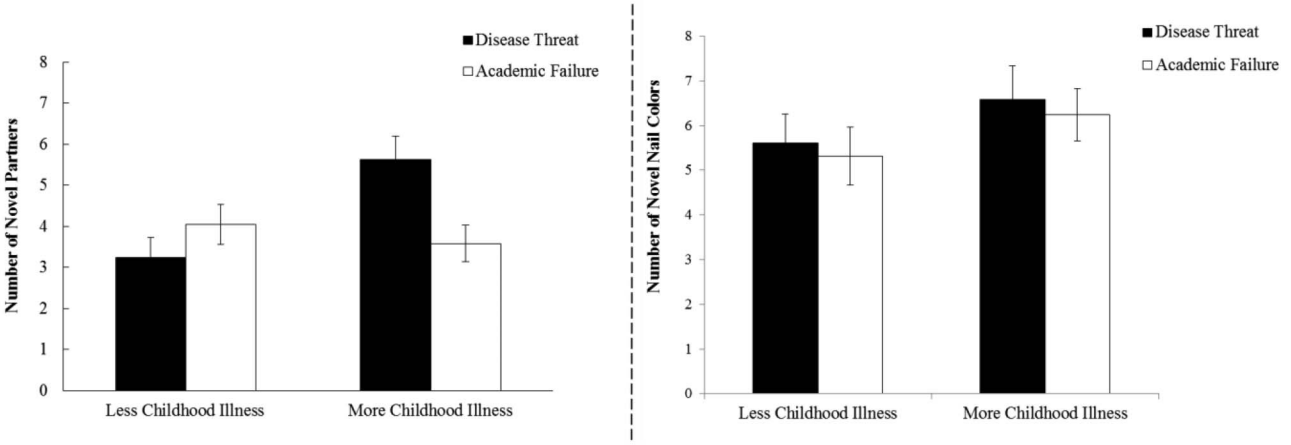

Figure 5. Women's preferred number of novel dating partners and nail polish colors as a function of priming condition (disease threat vs. academic failure) and history of childhood illness (Experiment 5). Plotted means represent one standard deviation above and below the mean childhood illness. Error bars reflect the standard error of the mean.

adds to a growing literature on mate preferences (Buss & Schmitt, 1993; Gangestad & Simpson, 2000; Gangestad et al., 2005a, 2005b; Schmitt, 2003; Schmitt, Shackelford, & Buss, 2001), diversified bet-hedging (Evans et al., 2012; Foerster et al., 2003; Jennions & Petrie, 2000; Sherman et al., 1988; White, Li, Griskevicius, Neuberg, & Kenrick, 2013), and the impact of disease threat on both social cognition (Duncan & Schaller, 2009; Duncan et al., 2009; Miller & Maner, 2011, 2012; Murray et al., 2013; Neuberg et al., 2011; Park et al., 2003; Schaller & Park, 2011) and mate preferences (Gangestad & Buss, 1993; Lee & Zietsch, 2011; Little et al., 2011; Tybur & Gangestad, 2011; Welling et al., 2007; Young, Sacco, & Hugenberg, 2011).

Although the current experiments represent an important step in determining the effects of disease vulnerability on women's mating psychology, future experiments are needed to examine more fully the nature of the psychological and behavioral changes that people experience in response to these threats. For example, across some of our experiments, there was a trend among women low in perceived vulnerability to disease to express a preference for *fewer* novel partners when exposed to disease (vs. control) cues. Although these comparisons were statistically nonsignificant and were not predicted in advance, this pattern of results would not be inconsistent with the proposed diversified bet-hedging hypothesis. According to the bet-hedging hypothesis, disease-vulnerable females prefer to mate with different partners in response to disease threat as a means of increasing their long-term reproductive success by securing a variety of genotypes for their offspring (i.e., a "proactive" rather than "reactive" response to pathogen cues; see, e.g., Schaller, 2014; Stevenson et al., 2011). For women whose own immune genes have proven themselves effective in combating a variety of illnesses—and who therefore have the luxury of pursuing a single male mating strategy in the face of a growing disease threat—cues indicating a raising threat of disease may simply produce a reactive response aimed at minimizing their current risk of illness and disease. Future research should more systematically test the effects of disease cues on individuals who perceive themselves to be less vulnerable to these types of threats.

Similarly, it is important to address the fact that the results of our experiments may seem to contradict research that finds that individuals who fear illness and disease (measured by the germ aversion—rather than perceived infectability—subscale of the PVD), report more conservative and restricted sexual attitudes in the face of disease threat cues (Murray et al., 2013).[12] However, it is likely that these different patterns of results reflect different sets of decision-making processes being activated in response to distal versus more immediate disease threat cues. The disease threat manipulation used in the current research was designed to activate proactive, long-term strategies aimed at increasing the survivability of one's offspring lineage in the face of a growing, but latent threat of disease and infection (for a discussion on proactive vs. reactive strategies to minimize disease threats see Schaller, 2014; Stevenson et al., 2011). Accordingly, the disease threat cues used in the current research emphasized that the rate of disease is expected to increase in the environment, but did not imply that one's immediate risk of contagious illness was elevated. This type of disease threat stands in contrast to the types of cues found to promote increased sexual restrictedness. The latter types of cues focus on one's immediate risk of infection/illness, activating more reactive, disgust-based cognitions that promote prophylaxis, including sexual inhibition (Murray et al., 2013; Tybur, Bryan, Magnan, & Hooper, 2011). Indeed, the women in the current research did not exhibit a greater desire for novel partners when

[12] We ran analogous multiple regression analyses for Experiments 1 through 4 including germ aversion (as opposed to PVD-PI; Duncan et al., 2009) as our moderator. Necessary covariates included in the original analyses (, e.g., between-conditions differences in affect) were also included in these analyses. Unlike the measure of perceived infectability, germ aversion did not significantly interact with our experimental prime (highest order interaction for Experiment 1: $p = .58$; Experiment 2: $ps \geq .14$; Experiment 3: $p = .52$; Experiment 4: $p = .63$). Further, our regression analyses did not reveal significant main effects of germ aversion on our respective dependent measures (main effect of germ aversion for Experiment 1: $\beta = .01$, $p = .94$; Experiment 2: $\beta = .008$, $p = .93$; Experiment 3: $\beta = -.15$, $p = .23$; Experiment 4: $\beta = -.03$, $p = .69$).

they were exposed to cues indicating a greater risk of immediate, minor infection (the minor disease threat condition used in Experiment 2). When taken together with this past research, the current research suggests that, although immediate relatively minor infection concerns may increase sexual restrictedness, a more distal threat of rapidly increasing rates of serious illness and disease in one's environment may yield the opposite effect: leading those women who are most vulnerable to these threats to experience a strategic shift in mating psychology that may actually promote *increased* sexual novelty and variety seeking. In such conditions, the long-term fitness benefits available from having genetically diverse offspring are sufficiently great to offset the short-term, more immediate concerns of infection risk.

The current research was also limited in its focus on young, fairly healthy college students. Future research would benefit from examining whether our effects can be replicated in a more diverse population of women. The majority of our participants came from middle-class backgrounds and were raised in benign, nutrient-rich, and sanitary environments. Research has found that a variety of environmental stressors present in early childhood, such as lower socioeconomic status and fluctuating nutrition quality in utero, can lead to reduced immune system functioning in adulthood (Kuzawa & Quinn, 2009; McDade, 2005; Miller et al., 2009; Rickard, Frankenhuis, & Nettle, 2014). Accordingly, it is possible that a more diverse sample that includes a greater proportion of individuals from adverse, pathogen-rich environments would be more sensitive to cues signaling disease threat and demonstrate a stronger response to our experimental prime than participants in our current studies. Although future research is needed to examine analogous effects in more diverse populations, it is nonetheless a strength of the current work that we found the emergence of these sexual variety seeking effects even within samples of women from relatively advantaged, pathogen-free environments.

Another limitation to the current research is that we did not measure genetic bet-hedging directly. Although our results were consistent with predictions derived from a bet-hedging perspective, our dependent measures assessed women's self-reported interest in sexual variety (Experiments 1–2) and desire to date a variety of partners (Experiments 3–5). Accordingly, it is possible that the demonstrated effects of disease threat on women's mating psychology and sexual decision-making may not extend to influence their actual sexual and reproductive behaviors. Indeed, numerous studies have demonstrated women's clear and consistent preference for monogamous, committed (vs. casual, short-term) relationships (e.g., Buss, 2008; Buss & Schmitt, 1993), and women remain influenced by societal pressures to be more sexually restricted than men (Freitas, 2008). Testing whether the exhibited shifts are sufficiently robust to overcome these opposing forces is therefore a critical next step in the current line of research. However, that our experimental prime was able to shift women away from these evolutionarily and socially reinforced preferences toward a strategy prioritizing sexual variety illustrates the strength of the conceptual link between the threat of disease on one hand, and women's sexual decision-making on the other.

Lastly, although beyond the scope of the current investigation, a life history perspective suggests that men's psychology and behavior should also be sensitive to early environmental stress and hardship (Ellis, Figueredo, Brumbach, & Schlomer, 2009), as well as early exposure to disease (McDade, 2003). Although we did not find an effect of disease upon men's sexual variety seeking, it is possible that vulnerability to illness might still affect men's mating psychology in other ways. Indeed, researchers have noted that chronic disease in childhood is associated with earlier age of first reproduction in individuals of both sexes (Waynforth, 2012), suggesting that disease may impact men's mating psychology in ways outside of sexual variety seeking. Future research should examine how local cues to disease threat and developmental history of disease might influence different forms of mating-relevant attitudes and behaviors among men.

Conclusion

The preference for a variety of mates has been demonstrated in females across a number of diverse species (e.g., Griffith et al., 2002). Mating with a variety of partners has been shown to increase the reproductive success of females in contexts characterized by high levels of disease by ensuring that some of their offspring will possess the genes necessary to survive and thrive under these conditions (e.g., Fox & Rauter, 2003). In the current research, we demonstrated that disease cues may similarly affect women's mating psychology. Specifically, we demonstrated that women who are most vulnerable to disease respond to disease cues by preferring a variety of novel male partners. The present experiments therefore provide some of the first evidence of a conceptual link between pathogen load, personal immunocompetence, and women's mating strategies. As such, vulnerability to disease—based on developmental history and current exposure to disease threat—may be an important and largely unexamined factor that influences sexual decision-making among women.

References

Alexander, R. D., & Noonan, K. M. (1979). Concealment of ovulation, parental care and human social evolution. In N. A. Chagnon & W. G. Irons (Eds.), *Evolutionary biology and human social behavior: An anthropological perspective* (pp. 436–453). North Scituate, MA: Duxbury Press.

Anderson, K. G. (2006). How well does paternity confidence match actual paternity? *Current Anthropology, 47,* 513–520. http://dx.doi.org/10.1086/504167

Anderson, K. G., Kaplan, H., & Lancaster, J. (1999). Paternal care by genetic fathers and stepfathers. I: Reports from Albuquerque men. *Evolution and Human Behavior, 20,* 405–431. http://dx.doi.org/10.1016/S1090-5138(99)00023-9

Apicella, C. L., & Marlowe, F. W. (2004). Perceived male fidelity and paternal resemblance predict men's investment in children. *Evolution and Human Behavior, 25,* 371–378. http://dx.doi.org/10.1016/j.evolhumbehav.2004.06.003

Baer, B., & Schmid-Hempel, P. (1999). Experimental variation in polyandry affects parasite loads and fitness in a bumble-bee. *Nature, 397,* 151–154. http://dx.doi.org/10.1038/16451

Barbosa, M., Dornelas, M., & Magurran, A. E. (2010). Effects of polyandry on male phenotypic diversity. *Journal of Evolutionary Biology, 23,* 2442–2452. http://dx.doi.org/10.1111/j.1420-9101.2010.02105.x

Barker, D. J., Godfrey, K. M., Fall, C., Osmond, C., Winter, P. D., & Shaheen, S. O. (1991). Relation of birth weight and childhood respiratory infection to adult lung function and death from chronic obstructive airways disease. *British Medical Journal, 303,* 671–675. http://dx.doi.org/10.1136/bmj.303.6804.671

Barker, D. J., & Osmond, C. (1986). Childhood respiratory infection and adult chronic bronchitis in England and Wales. *British Medical Journal, 293,* 1271–1275. http://dx.doi.org/10.1136/bmj.293.6557.1271

Bateman, A. J. (1948). Intra-sexual selection in Drosophila. *Heredity, 2,* 349–368. http://dx.doi.org/10.1038/hdy.1948.21

Birkhead, T. R., & Møller, A. P. (1998). *Sperm competition and sexual selection*. London, UK: Academic Press.

Brouwer, L., Barr, I., van de Pol, M., Burke, T., Komdeur, J., & Richardson, D. S. (2010). MHC-dependent survival in a wild population: Evidence for hidden genetic benefits gained through extra-pair fertilizations. *Molecular Ecology, 19,* 3444–3455. http://dx.doi.org/10.1111/j.1365-294X.2010.04750.x

Buss, D. M. (1989). Sex differences in human mate preferences: Evolutionary hypotheses tested in 37 cultures. *Behavioral and Brain Sciences, 12,* 1–14. http://dx.doi.org/10.1017/S0140525X00023992

Buss, D. M. (2008). *Evolutionary psychology: The new science of the mind*. Boston, MA: Pearson Education, Inc.

Buss, D. M., & Schmitt, D. P. (1993). Sexual strategies theory: An evolutionary perspective on human mating. *Psychological Review, 100,* 204–232. http://dx.doi.org/10.1037/0033-295X.100.2.204

Casanova, J. L., Abel, L., & Quintana-Murci, L. (2011). Human TLRs and IL-1Rs in host defense: Natural insights from evolutionary, epidemiological, and clinical genetics. *Annual Review of Immunology, 29,* 447–491. http://dx.doi.org/10.1146/annurev-immunol-030409-101335

Cerda-Flores, R. M., Barton, S. A., Marty-Gonzalez, L. F., Rivas, F., & Chakraborty, R. (1999). Estimation of nonpaternity in the Mexican population of Nuevo Leon: A validation study with blood group markers. *American Journal of Physical Anthropology, 109,* 281–293. http://dx.doi.org/10.1002/(SICI)1096-8644(199907)109:3<281::AID-AJPA1>3.0.CO;2-3

Deckman, T., & DeWall, N. C. (2011). Negative urgency and risky sexual behaviors: A clarification of the relationship between impulsivity and risky sexual behavior. *Personality and Individual Differences, 51,* 674–678. http://dx.doi.org/10.1016/j.paid.2011.06.004

Delves, P. J., Martin, S. J., Burton, D. R., & Roitt, I. M. (2011). *Roitt's essential immunology* (Vol. *20*). Hoboken, NJ: Wiley.

Duncan, L. A., & Schaller, M. (2009). Prejudicial attitudes toward older adults may be exaggerated when people feel vulnerable to infectious disease: Evidence and implications. *Analyses of Social Issues and Public Policy, 9,* 97–115. http://dx.doi.org/10.1111/j.1530-2415.2009.01188.x

Duncan, L. A., Schaller, M., & Park, J. H. (2009). Perceived vulnerability to disease: Development and validation of a 15-item self-report instrument. *Personality and Individual Differences, 47,* 541–546. http://dx.doi.org/10.1016/j.paid.2009.05.001

Ellis, B. J., Figueredo, A. J., Brumbach, B. H., & Schlomer, G. L. (2009). Fundamental dimensions of environmental risk. *Human Nature, 20,* 204–268. http://dx.doi.org/10.1007/s12110-009-9063-7

Evans, M. L., Dionne, M., Miller, K. M., & Bernatchez, L. (2012). Mate choice for major histocompatibility complex genetic divergence as a bet-hedging strategy in the Atlantic salmon (*Salmo salar*). *Proceedings of the Royal Society B: Biological Sciences, 279,* 379–386. http://dx.doi.org/10.1098/rspb.2011.0909

Fietz, J., Zischler, H., Schwiegk, C., Tomiuk, J., Dausmann, K. H., & Ganzhorn, J. U. (2000). High rates of extra-pair young in the pair-living fat-tailed dwarf lemur, *Cheirogaleus medius*. Behavioral Ecology and Sociobiology, *49,* 8–17. http://dx.doi.org/10.1007/s002650000269

Foerster, K., Delhey, K., Johnsen, A., Lifjeld, J. T., & Kempenaers, B. (2003). Females increase offspring heterozygosity and fitness through extra-pair matings. *Nature, 425,* 714–717. http://dx.doi.org/10.1038/nature01969

Fox, C. W., & Rauter, C. M. (2003). Bet-hedging and the evolution of multiple mating. *Evolutionary Ecology Research, 5,* 273–286.

Freitas, D. (2008). *Sex and the soul: Juggling sexuality, spirituality, romance, and religion on America's college campuses*. New York, NY: Oxford University Press.

Gangestad, S. W., & Buss, D. M. (1993). Pathogen prevalence and human mate preferences. *Ethology and Sociobiology, 14,* 89–96. http://dx.doi.org/10.1016/0162-3095(93)90009-7

Gangestad, S. W., Garver-Apgar, C. E., Simpson, J. A., & Cousins, A. J. (2007). Changes in women's mate preferences across the ovulatory cycle. *Journal of Personality and Social Psychology, 92,* 151–163. http://dx.doi.org/10.1037/0022-3514.92.1.151

Gangestad, S. W., & Simpson, J. A. (2000). The evolution of human mating: Trade-offs and strategic pluralism. *Behavioral and Brain Sciences, 23,* 573–587. http://dx.doi.org/10.1017/S0140525X0000337X

Gangestad, S. W., & Thornhill, R. (2003). Facial masculinity and fluctuating asymmetry. *Evolution and Human Behavior, 24,* 231–241. http://dx.doi.org/10.1016/S1090-5138(03)00017-5

Gangestad, S. W., Thornhill, R., & Garver-Apgar, C. E. (2005a). Women's sexual interests across the ovulatory cycle depend on primary partner developmental instability. *Proceedings: Biological Sciences, 272,* 2023–2027. http://dx.doi.org/10.1098/rspb.2005.3112

Gangestad, S. W., Thornhill, R., & Garver-Apgar, C. E. (2005b). Adaptations to ovulation implications for sexual and social behavior. *Current Directions in Psychological Science, 14,* 312–316. http://dx.doi.org/10.1111/j.0963-7214.2005.00388.x

Geary, D. C. (2000). Evolution and proximate expression of human paternal investment. *Psychological Bulletin, 126,* 55–77. http://dx.doi.org/10.1037/0033-2909.126.1.55

Gillespie, J. H. (1974). Natural selection for within-generation variance in offspring number. *Genetics, 76,* 601–606.

Gillespie, J. H. (1977). Natural selection for variance in offspring numbers: A new evolutionary principle. *American Naturalist, 111,* 1010–1014. http://dx.doi.org/10.1086/283230

Greiling, H., & Buss, D. M. (2000). Women's sexual strategies: The hidden dimension of extra-pair mating. *Personality and Individual Differences, 28,* 929–963. http://dx.doi.org/10.1016/S0191-8869(99)00151-8

Griffith, S. C., Owens, I. P., & Thuman, K. A. (2002). Extra pair paternity in birds: A review of interspecific variation and adaptive function. *Molecular Ecology, 11,* 2195–2212. http://dx.doi.org/10.1046/j.1365-294X.2002.01613.x

Hamilton, W. D. (1980). Sex versus non-sex versus parasite. *Oikos, 35,* 282–290. http://dx.doi.org/10.2307/3544435

Hamilton, W. D. (1982). Pathogens as causes of genetic diversity in their host populations. In R. M. Anderson & R. M. May (Eds.), *Population biology of infectious diseases* (pp. 269–296). Berlin, Germany: Springer-Verlag. http://dx.doi.org/10.1007/978-3-642-68635-1_14

Hamilton, W. D., Axelrod, R., & Tanese, R. (1990). Sexual reproduction as an adaptation to resist parasites (a review). *Proceedings of the National Academy of Sciences of the United States of America, 87,* 3566–3573. http://dx.doi.org/10.1073/pnas.87.9.3566

Haselton, M. G., & Gangestad, S. W. (2006). Conditional expression of women's desires and men's mate guarding across the ovulatory cycle. *Hormones and Behavior, 49,* 509–518. http://dx.doi.org/10.1016/j.yhbeh.2005.10.006

Hendrick, C., Hendrick, S. S., & Reich, D. A. (2006). The brief sexual attitudes scale. *Journal of Sex Research, 43,* 76–86. http://dx.doi.org/10.1080/00224490609552301

Hill, S. E., DelPriore, D. J., Rodeheffer, C. D., & Butterfield, M. E. (2014). The effect of ecological harshness on perceptions of the ideal female body size: An experimental life history approach. *Evolution and Human Behavior, 35,* 148–154. http://dx.doi.org/10.1016/j.evolhumbehav.2013.12.005

Hill, S. E., Rodeheffer, C. D., Griskevicius, V., Durante, K., & White, A. E. (2012). Boosting beauty in an economic decline: Mating, spending, and

the lipstick effect. *Journal of Personality and Social Psychology, 103,* 275–291. http://dx.doi.org/10.1037/a0028657

Horowitz, A., Strauss-Albee, D. M., Leipold, M., Kubo, J., Nemat-Gorgani, N., Dogan, O. C., . . . Blish, C. A. (2013). Genetic and environmental determinants of human NK cell diversity revealed by mass cytometry. *Science Translational Medicine, 5,* 208ra145–208ra145. http://dx.doi.org/10.1126/scitranslmed.3006702

Howard, R. S., & Lively, C. M. (1994). Parasitism, mutation accumulation and the maintenance of sex. *Nature, 367,* 554–557. http://dx.doi.org/10.1038/367554a0

Jaenike, J. (1978). An hypothesis to account for the maintenance of sex within populations. *Evolutionary Theory, 3,* 191–194.

Jennions, M. D., & Petrie, M. (2000). Why do females mate multiply? A review of the genetic benefits. *Biological Reviews of the Cambridge Philosophical Society, 75,* 21–64. http://dx.doi.org/10.1017/S0006323199005423

Johnson, E. M. (2013, December 04). Promiscuity is pragmatic: Why women and other female primates seek out multiple partners. *Slate*. Retrieved from http://www.slate.com

Kalichman, S. C., & Rompa, D. (1995). Sexual sensation seeking and sexual compulsivity Scales: Reliability, validity, and predicting HIV risk behavior. *Journal of Personality Assessment, 65,* 586–601. http://dx.doi.org/10.1207/s15327752jpa6503_16

Kaplan, R. H., & Cooper, W. S. (1984). The evolution of developmental plasticity in reproductive characteristics: An application of the "adaptive coin-flipping" principle. *American Naturalist, 123,* 393–410. http://dx.doi.org/10.1086/284211

Keller, L. (1995). Evolutionary biology. All's fair when love is war. *Nature, 373,* 190–191. http://dx.doi.org/10.1038/373190a0

Keller, L., & Reeve, H. K. (1994). Genetic variability, queen number, and polyandry in social Hymenoptera. *Evolution; International Journal of Organic Evolution, 48,* 694–704. http://dx.doi.org/10.2307/2410479

Keller, L., & Reeve, H. K. (1995). Why do females mate with multiple males? The sexually selected sperm hypothesis. *Advances in the Study of Behavior, 24,* 291–316. http://dx.doi.org/10.1016/S0065-3454(08)60397-6

Kuzawa, C. W., & Quinn, E. A. (2009). Developmental origins of adult function and health: Evolutionary hypotheses. *Annual Review of Anthropology, 38,* 131–147. http://dx.doi.org/10.1146/annurev-anthro-091908-164350

Lee, A. J., & Zietsch, B. P. (2011). Experimental evidence that women's mate preferences are directly influenced by cues of pathogen prevalence and resource scarcity. *Biology Letters, 7,* 892–895. http://dx.doi.org/10.1098/rsbl.2011.0454

Liersch, S., & Schmid-Hempel, P. (1998). Genetic variation within social insect colonies reduces parasite load. *Proceedings of the Royal Society of London, Series B: Biological Sciences, 265,* 221–225. http://dx.doi.org/10.1098/rspb.1998.0285

Little, A. C., DeBruine, L. M., & Jones, B. C. (2011). Exposure to visual cues of pathogen contagion changes preferences for masculinity and symmetry in opposite-sex faces. *Proceedings of the Royal Society B: Biological Sciences, 278,* 2032–2039. http://dx.doi.org/10.1098/rspb.2010.1925

Lively, C. M. (2010). Parasite virulence, host life history, and the costs and benefits of sex. *Ecology, 91,* 3–6. http://dx.doi.org/10.1890/09-1158.1

Lively, C. M., Craddock, C., & Vrijenhoek, R. C. (1990). Red Queen hypothesis supported by parasitism in sexual and clonal fish. *Nature, 344,* 864–866. http://dx.doi.org/10.1038/344864a0

McDade, T. W. (2003). Life history theory and the immune system: Steps toward a human ecological immunology. *American Journal of Physical Anthropology, 122,* 100–125. http://dx.doi.org/10.1002/ajpa.10398

McDade, T. W. (2005). Life history, maintenance, and the early origins of immune function. *American Journal of Human Biology, 17,* 81–94. http://dx.doi.org/10.1002/ajhb.20095

Miller, G. E., Chen, E., Fok, A. K., Walker, H., Lim, A., Nicholls, E. F., . . . Kobor, M. S. (2009). Low early-life social class leaves a biological residue manifested by decreased glucocorticoid and increased proinflammatory signaling. *Proceedings of the National Academy of Sciences of the United States of America, 106,* 14716–14721. http://dx.doi.org/10.1073/pnas.0902971106

Miller, S. L., & Maner, J. K. (2011). Sick body, vigilant mind: The biological immune system activates the behavioral immune system. *Psychological Science, 22,* 1467–1471. http://dx.doi.org/10.1177/0956797611420166

Miller, S. L., & Maner, J. K. (2012). Overperceiving disease cues: The basic cognition of the behavioral immune system. *Journal of Personality and Social Psychology, 102,* 1198–1213. http://dx.doi.org/10.1037/a0027198

Murphy, K. (2011). *Janeway's immunobiology*. New York, NY: Garland Science.

Murray, D. R., Jones, D. N., & Schaller, M. (2013). Perceived threat of infectious disease and its implications for sexual attitudes. *Personality and Individual Differences, 54,* 103–108. http://dx.doi.org/10.1016/j.paid.2012.08.021

Neuberg, S. L., Kenrick, D. T., & Schaller, M. (2011). Human threat management systems: Self-protection and disease avoidance. *Neuroscience and Biobehavioral Reviews, 35,* 1042–1051. http://dx.doi.org/10.1016/j.neubiorev.2010.08.011

Olofsson, H., Ripa, J., & Jonzén, N. (2009). Bet-hedging as an evolutionary game: The trade-off between egg size and number. *Proceedings of the Royal Society B: Biological Sciences, 276,* 2963–2969. http://dx.doi.org/10.1098/rspb.2009.0500

Palombit, R. A. (1994). Extra-pair copulations in a monogamous ape. *Animal Behaviour, 47,* 721–723. http://dx.doi.org/10.1006/anbe.1994.1097

Park, J. H., Faulkner, J., & Schaller, M. (2003). Evolved disease-avoidance processes and contemporary anti-social behavior: Prejudicial attitudes and avoidance of people with physical disabilities. *Journal of Nonverbal Behavior, 27,* 65–87. http://dx.doi.org/10.1023/A:1023910408854

Petrie, M., & Kempenaers, B. (1998). Extra-pair paternity in birds: Explaining variation between species and populations. *Trends in Ecology & Evolution, 13,* 52–58. http://dx.doi.org/10.1016/S0169-5347(97)01232-9

Philippi, T., & Seger, J. (1989). Hedging one's evolutionary bets, revisited. *Trends in Ecology & Evolution, 4,* 41–44. http://dx.doi.org/10.1016/0169-5347(89)90138-9

Pillsworth, E. G., & Haselton, M. G. (2006). Male sexual attractiveness predicts differential ovulatory shifts in female extra-pair attraction and male mate retention. *Evolution and Human Behavior, 27,* 247–258. http://dx.doi.org/10.1016/j.evolhumbehav.2005.10.002

Ponnamperuma, S. (2013). Kasyapa. In S. Ponnamperuma (Ed.), *The story of Sigiriya* (pp. 19–22). Melbourne, Australia: Panique Pty Ltd.

Reichard, U. (1995). Extra-pair copulations in a monogamous gibbon (Hylobates lar). *Ethology, 100,* 99–112. http://dx.doi.org/10.1111/j.1439-0310.1995.tb00319.x

Rickard, I. J., Frankenhuis, W. E., & Nettle, D. (2014). Why are childhood family factors associated with timing of maturation? A role for internal prediction. *Perspectives on Psychological Science, 9,* 3–15. http://dx.doi.org/10.1177/1745691613513467

Ridley, M. (1994). *The red queen: Sex and the evolution of human nature*. London, UK: Penguin UK.

Salathé, M., Kouyos, R. D., Regoes, R. R., & Bonhoeffer, S. (2008). Rapid parasite adaptation drives selection for high recombination rates. *Evolution; International Journal of Organic Evolution, 62,* 295–300. http://dx.doi.org/10.1111/j.1558-5646.2007.00265.x

Sasse, G., Müller, H., Chakraborty, R., & Ott, J. (1994). Estimating the frequency of nonpaternity in Switzerland. *Human Heredity, 44,* 337–343. http://dx.doi.org/10.1159/000154241

Scelza, B. A. (2011). Female choice and extra-pair paternity in a traditional human population. *Biology Letters, 7,* 889–891. http://dx.doi.org/10.1098/rsbl.2011.0478

Schaller, M. (2014). When and how disgust is and is not implicated in the behavioral immune system. *Evolutionary Behavioral Sciences, 8,* 251–256. http://dx.doi.org/10.1037/ebs0000019

Schaller, M., & Park, J. H. (2011). The behavioral immune system (and why it matters). *Current Directions in Psychological Science, 20,* 99–103. http://dx.doi.org/10.1177/0963721411402596

Schmitt, D. P. (2003). Universal sex differences in the desire for sexual variety: Tests from 52 nations, 6 continents, and 13 islands. *Journal of Personality and Social Psychology, 85,* 85–104. http://dx.doi.org/10.1037/0022-3514.85.1.85

Schmitt, D. P., Shackelford, T. K., & Buss, D. M. (2001). Are men really more 'oriented' toward short-term mating than women? A critical review of theory and research. *Psychology, Evolution & Gender, 3,* 211–239. http://dx.doi.org/10.1080/14616660110119331

Schmitt, D. P., Shackelford, T. K., Duntley, J., Tooke, W., & Buss, D. M. (2001). The desire for sexual variety as a key to understanding basic human mating strategies. *Personal Relationships, 8,* 425–455. http://dx.doi.org/10.1111/j.1475-6811.2001.tb00049.x

Seeley, T. D., & Tarpy, D. R. (2007). Queen promiscuity lowers disease within honeybee colonies. *Proceedings: Biological Sciences, 274,* 67–72. http://dx.doi.org/10.1098/rspb.2006.3702

Seger, J., & Brockmann, H. J. (1987). What is bet-hedging? *Oxford Surveys in Evolutionary Biology, 4,* 182–211.

Sherman, P. W., Seeley, T. D., & Reeve, H. K. (1988). Parasites, pathogens, and polyandry in social Hymenoptera. *American Naturalist, 131,* 602–610. http://dx.doi.org/10.1086/284809

Simmons, L. W. (2005). The evolution of polyandry: Sperm competition, sperm selection, and offspring viability. *Annual Review of Ecology Evolution and Systematics, 36,* 125–146. http://dx.doi.org/10.1146/annurev.ecolsys.36.102403.112501

Simons, A. M. (2007). Selection for increased allocation to offspring number under environmental unpredictability. *Journal of Evolutionary Biology, 20,* 813–817. http://dx.doi.org/10.1111/j.1420-9101.2006.01270.x

Smith, J. M. (1978). *The evolution of sex*. Cambridge, UK: Cambridge University Press.

Stevenson, R. J., Case, T. I., & Oaten, M. J. (2011). Proactive strategies to avoid infectious disease. *Philosophical Transactions of the Royal Society of London Series B, Biological Sciences, 366,* 3361–3363. http://dx.doi.org/10.1098/rstb.2011.0170

Symons, D. (1979). *The evolution of human sexuality*. New York, NY: Oxford Press.

Tarpy, D. R. (2003). Genetic diversity within honeybee colonies prevents severe infections and promotes colony growth. *Proceedings of the Royal Society of London, Series B: Biological Sciences, 270,* 99–103. http://dx.doi.org/10.1098/rspb.2002.2199

Tarpy, D. R., & Seeley, T. D. (2006). Lower disease infections in honeybee (Apis mellifera) colonies headed by polyandrous vs. monandrous queens. *Naturwissenschaften, 93,* 195–199. http://dx.doi.org/10.1007/s00114-006-0091-4

Thornhill, R., & Gangestad, S. W. (2006). Facial sexual dimorphism, developmental stability, and susceptibility to disease in men and women. *Evolution and Human Behavior, 27,* 131–144. http://dx.doi.org/10.1016/j.evolhumbehav.2005.06.001

Townsend, R. F. (2000). *The Aztecs* (2nd ed., rev.). London, UK: Thames & Hudson.

Trivers, R. L. (1972). Parental investment and sexual selection. In B. Campbell (Ed.), *Sexual selection and the descent of man: 1871–1971* (pp. 136–179). Chicago, IL: Aldine.

Tybur, J. M., Bryan, A. D., Magnan, R. E., & Hooper, A. E. C. (2011). Smells like safe sex: Olfactory pathogen primes increase intentions to use condoms. *Psychological Science, 22,* 478–480. http://dx.doi.org/10.1177/0956797611400096

Tybur, J. M., & Gangestad, S. W. (2011). Mate preferences and infectious disease: Theoretical considerations and evidence in humans. *Philosophical Transactions of the Royal Society of London Series B, Biological Sciences, 366,* 3375–3388. http://dx.doi.org/10.1098/rstb.2011.0136

Van Valen, L. (1973). A new evolutionary law. *Evolutionary Theory, 1,* 1–30.

Vrijenhoek, R. C. (1993). The origin and evolution of clones versus the maintenance of sex in Poeciliopsis. *The Journal of Heredity, 84,* 388–395.

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. http://dx.doi.org/10.1037/0022-3514.54.6.1063

Watson, P. J. (1991). Multiple paternity as genetic bet-hedging in female sierra dome spiders, *Linyphia litigiosa (Linyphiidae). Animal Behaviour, 41,* 343–360. http://dx.doi.org/10.1016/S0003-3472(05)80486-5

Waynforth, D. (2012). Life-history theory, chronic childhood illness and the timing of first reproduction in a British birth cohort. *Proceedings of the Royal Society B: Biological Sciences, 279,* 2998–3002. http://dx.doi.org/10.1098/rspb.2012.0220

Welling, L. L., Conway, C. A., DeBruine, L. M., & Jones, B. C. (2007). Perceived vulnerability to disease is positively related to the strength of preferences for apparent health in faces. *Journal of Evolutionary Psychology (Budapest), 5,* 131–139. http://dx.doi.org/10.1556/JEP.2007.1012

West, L. J. (2002). Defining critical windows in the development of the human immune system. *Human and Experimental Toxicology, 21,* 499–505. http://dx.doi.org/10.1191/0960327102ht288oa

Westneat, D. F., Sherman, P. W., & Morton, M. L. (1990). The ecology and evolution of extra-pair copulations in birds. *Current Ornithology, 7,* 331–369.

White, A. E., Li, Y. J., Griskevicius, V., Neuberg, S. L., & Kenrick, D. T. (2013). Putting all your eggs in one basket: Life-history strategies, bet hedging, and diversification. *Psychological Science, 24,* 715–722. http://dx.doi.org/10.1177/0956797612461919

Yasui, Y. (1998). The 'genetic benefits' of female multiple mating reconsidered. *Trends in Ecology & Evolution, 13,* 246–250. http://dx.doi.org/10.1016/S0169-5347(98)01383-4

Yasui, Y. (2001). Female multiple mating as a genetic bet-hedging strategy when mate choice criteria are unreliable. *Ecological Research, 16,* 605–616. http://dx.doi.org/10.1046/j.1440-1703.2001.00423.x

Young, S. G., Sacco, D. F., & Hugenberg, K. (2011). Vulnerability to disease is associated with a domain-specific preference for symmetrical faces relative to symmetrical non-face stimuli. *European Journal of Social Psychology, 41,* 558–563. http://dx.doi.org/10.1002/ejsp.800

Received June 27, 2014
Revision received April 17, 2015
Accepted April 22, 2015 ■