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Perceived threat of infectious disease and its implications for sexual attitudes

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ABSTRACT

A study ($n = 411$) investigated the relationship between chronic individual differences in germ aversion and sociosexual attitudes (short-term mating orientation, long-term mating orientation, and anticipated future sexual promiscuity), and also tested whether the magnitudes of these relations differ depending on the temporary perceptual salience of disease threat. Results revealed person-by-situation interactions. When the threat of disease was temporarily salient, germ aversion correlated negatively with short-term mating orientation and with future sexual promiscuity, and correlated positively with long-term mating orientation; these effects were either weaker or nonexistent under control conditions. These effects emerged most clearly among women

1. Introduction

Attitudes towards casual sex differ greatly between individuals. Surveys have found that while a large proportion of men and women label themselves as comfortable monogamists, another significant proportion are comfortable having casual sex with many different partners (e.g. Laumann, Gagnon, Michael, & Michaels, 1994). These attitudes are emblematic of a distinction between *restricted* and *unrestricted* sociosexual attitudes, or between *long-term* and *short-term* mating styles (Jackson & Kirkpatrick, 2007; Simpson & Gangestad, 1991). Individual differences in long-term versus short-term mating styles have many implications. For instance, individuals who are dispositionally inclined toward a short-term mating style (i.e., are more inclined toward casual sex and multiple sexual partners) place higher priority on physical attractiveness when choosing a mate and exhibit reduced commitment to ongoing romantic relationships (Simpson & Gangestad, 1991).

Most research exploring the influences on sexual attitudes has focused on variables that are typically predictive of stable individual differences, such as differences in genetics and early life experiences (Garcia et al., 2010; Newcomer & Udry, 1987). Although long-term and short-term mating styles are relatively stable across time, and can be empirically assessed as trait-like individual differences (Jackson & Kirkpatrick, 2007; Simpson & Gangestad, 1991), these dispositions can also vary across time and circumstances (Haselton & Gangestad, 2006; Pfeiffer, Verwoerdt, & Davis, 1972; Pillsworth & Haselton, 2006). These findings suggest that attitudes regarding long- and short-term mating are predicted not only by enduring individual differences, but also by temporary contextual cues. In this article, we report results from an investigation testing whether long-term and short-term mating styles—including attitudes pertaining to sexual promiscuity—might be influenced by the perceived threat of infectious disease. These results address three questions: (1) Are these mating styles predicted by chronic individual differences in perceived vulnerability to disease? (2) Do these effects differ depending on the temporary salience of disease transmission? (3) Do these effects differ between men and women?

In recent years there has emerged a considerable literature on the subjective perception of threat posed by infectious diseases and its implications for affect, cognition, and behavior (Curtis, de Barra, & Aunger, 2011; Oaten, Stevenson, & Case, 2009; Schaller & Park, 2011). Trait-like differences exist in the extent to which individuals perceive themselves as vulnerable to disease transmission—as indicated by individuals' self-assessments of immunocompetence, the extent to which they avoid situations associated with germ-transmission, and in the extent to which they experience a disgust response when presented with such situations (Duncan, Schaller, & Park, 2009; Haidt, McCauley, & Rozin, 1994; Tybur, Lieberman, & Griskevicius, 2009). These individual differences are correlated with a variety of traits and attitudes implying behavioral caution and attitudinal conservatism. Chronic germ aversion, for instance, correlates negatively with extraversion and openness to experience, and correlates positively with conformist attitudes (Duncan et al., 2009; Murray & Schaller, 2012; Wu & Chang, 2012).

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These relations can be understood as reflecting tradeoffs in an implicit cost-benefit analysis. Specific behavioral dispositions may have specific benefits, but can have disease-relevant costs as well. The ratio of benefits to costs varies depending upon the magnitude of threat posed by pathogen infection. Extraversion provides an illustrative example. Extraverted behavior is associated with social benefits (e.g., greater opportunities for social support); but, by exposing individuals to a larger number of people (who may be carriers of infectious diseases), extraversion is also associated with higher risk of pathogen infection (Hamrick, Cohen, & Rodriguez, 2002). The perceived magnitude of these costs is implicitly exaggerated for individuals who chronically perceive pathogens to pose a greater threat. To the extent that behavioral dispositions are responsive to implicit benefit/cost analysis, it follows that extraversion is likely to be lower among individuals who are chronically more germ-averse—and that is exactly what empirical results reveal (Duncan et al., 2009).

The predictive effects of chronic individual differences are complemented by—and sometimes moderated by—the effects of contextual cues that make the threat of disease transmission temporarily salient. Under experimental conditions in which the possibility of disease transmission is temporarily salient, people report lower levels of extraversion and higher levels of conformist attitudes (Mortensen, Becker, Ackerman, Neuberg, & Kenrick, 2010; Murray & Schaller, 2012; Wu & Chang, 2012). In addition, individual differences in perceived vulnerability to disease predict specific behavioral dispositions more strongly under conditions in which the threat of disease transmission is temporarily salient (Duncan & Schaller, 2009; Mortensen et al., 2010). These person-by-situation interactions are consistent with additional findings suggesting that individual differences in sensitivities to specific kinds of threats may predict relevant attitudes especially strongly under conditions in which cues connoting that particular kind of threat are perceptually salient (e.g., Schaller, Park, & Mueller, 2003).

The cost/benefit logic that links disease threat to extraversion and other behavioral attitudes can also be applied within the specific domain of sexual behavior. There can be interpersonal or hedonistic benefits associated with promiscuous sexual behavior, but unrestricted sexual behavior also has disease-specific costs. Sexual activity entails intimate interpersonal contact and thus carries with it a risk of disease transmission; indeed, many infections are transmitted almost exclusively through sexual contact. Consequently, unrestricted sexual behavior is associated with increased risk of contracting infectious diseases (Halperin & Epstein, 2004; Morris & Kretzschmar, 1997). The perceived magnitude of this cost is likely to be implicitly exaggerated among people who feel more vulnerable to disease transmission. It follows that individuals who feel more vulnerable to disease will be less inclined toward promiscuous short-term mating, and instead favour a long-term mating strategy (which implies relatively fewer lifetime sexual partners).

Preliminary evidence is consistent with this hypothesis. Duncan et al. (2009) reported correlations between two subscales of a Perceived Vulnerability to Disease questionnaire (PVD) and a Sociosexual Orientation Inventory (SOI; Simpson & Gangestad, 1991). Results revealed a weak correlation between SOI and PVD-Perceived Infectability ($r = -.14$) and a stronger correlation between SOI and PVD-Germ Aversion ($r = -.28$). A limitation of these results, however, is that the SOI questionnaire employed by Duncan et al. (2009) treated long- and short-term mating styles as opposite ends of a unidimensional continuum. Mating styles may be more accurately considered as conceptually distinct, context-contingent strategies (Gangestad & Simpson, 2000). Consistent with this conjecture are results showing that long- and short-term mating are somewhat orthogonal, and can be measured as distinct constructs (Jackson & Kirkpatrick, 2007). It remains to be tested whether individual differences in perceived vulnerability to disease primarily predicts attitudes specific to long-term mating, short-term mating, or both.

Another question that remains unanswered is whether any predictive effects of these individual differences might be moderated by the specific context within which mating orientations are assessed. Mortensen et al. (2010) found that it was primarily under conditions in which infectious disease was highly salient that chronically higher levels of perceived vulnerability to disease predicted lower levels of extraversion and openness to experience. Such a person-by-situation interaction may predict reported sexual attitudes as well.

Also unknown is whether there might be sex differences in the magnitude of relations between disease threat and attitudes toward long- and short-term mating. Men tend to be approach-oriented in the domain of sexual behavior, whereas women are more risk-averse (Haselton & Buss, 2000). One well-documented implication is that, compared to women, men are generally more attitudinally inclined toward short-term mating behavior (Schmitt, 2005). A less obvious implication is that, compared to men, women may be more sensitive to information implying increased costs associated with promiscuity—including the increased risk of disease-transmission. This implies the possibility that any relation between disease threat and mating orientation may be observed more strongly among women.

Some prior evidence is obliquely consistent with such a sex difference: In an analysis of nation-level mean values of pathogen prevalence and sexual attitudes, Schaller and Murray (2008) reported that in nations characterized by higher levels of disease-causing pathogens, people reported attitudes endorsing more restricted (i.e., less promiscuous) sexual behavior, and this effect emerged most strongly in the prediction of female attitudes. However, these results focused on ecological variation in pathogen prevalence (rather than perceived vulnerability to pathogens) predicting nation-level (rather than individual) sexual attitudes; no prior results have evaluated whether the hypothesized effects of perceived disease threat on short- and long-term mating attitudes might differ between the sexes.

1.1. Overview of the present investigation

Below we report the results from analyses on data obtained from young adults. All participants completed measures designed to assess perceived vulnerability to disease, as well as a revised version of the SOI, which independently assesses long- and short-term mating orientation. In addition, shortly before completing the revised SOI questionnaire, some participants were exposed to an experimental procedure designed to make the threat of disease temporarily salient. The experimental manipulation allowed us to test whether relations between PVD subscales and mating orientations were moderated by the temporary perceptual salience of the threat posed by disease transmission.

Two distinct versions of the disease threat manipulation were employed across two separate samples. We combined results across these two samples, and conducted primary analyses on the combined dataset. We did so for three main reasons. First, although procedurally different, the two manipulations were designed to serve a conceptually identical function. Second, previous experiments employing these manipulations have shown that they do produce conceptually identical effects on common outcome variables (Murray & Schaller, 2012; Wu & Chang, 2012). Third, by combining data across the two samples, we increased statistical power to detect sex differences and to test for effects within each sex separately. Statistical power was of special concern here because there was a relative paucity of men in the population from

which we sampled. We conducted preliminary statistical analyses (reported below) to ensure that the effects observed across the two samples were indeed comparable.

2. Methods

2.1. Participants

Participants were 411 undergraduate students (298 women, 113 men) from the University of British Columbia. The sample was ethnically diverse (242 participants reported Asian ethnic origin, 136 reported European origin, and 33 reported other ethnic origins). Participants completed the procedures either singly or in small groups.

2.2. Individual differences in perceived vulnerability to disease

Participants completed a set of questionnaires assessing demographic information and several other measures unrelated to the current investigation. Included was a 15-item questionnaire assessing individual differences in perceived vulnerability to disease (PVD; Duncan et al., 2009). Eight items measured individuals' avoidant response to situations that imply high likelihood of pathogen transmission (e.g. "I don't like to write with a pencil someone else has obviously chewed on"); these 8 items comprise a Germ Aversion subscale (PVD-GA; Cronbach's Alpha = .76). An additional 7 items measured individuals' self-perceived susceptibility to infectious diseases (e.g., "In general, I am very susceptible to colds, flu, and other infectious diseases"); these 7 items comprise a Perceived Infectability subscale (PVD-PI; Cronbach's Alpha = .91). These subscales were only weakly correlated ($r = .12$, $p = .01$). Preliminary analyses revealed weak and non-significant relations between PVD-PI and the primary outcome measures (results consistent with the weak relation between PVD-PI and SOI reported by Duncan et al., 2009, and consistent with PVD-PI's lack of association with other psychological variables that are associated with PVD-GA, e.g. Murray & Schaller, 2012). Consequently, PVD-PI is not considered further; analyses reported below focus just on the Germ-Aversion subscale (PVD-GA).

2.3. Experimental manipulation of disease salience

Across 2 separate samples, 2 different versions of an experimental manipulation were employed.

In one sample, 305 participants (225 women, 80 men) looked at 8 color photographs; the photographs differed across 3 experimental conditions (this manipulation was adapted from Schaller, Miller, Gervais, Yager, & Chen, 2010). In the Disease Threat condition, participants looked at photographs depicting people with obvious morphological or behavioral symptoms of infectious disease (e.g., skin lesions, sneezing). In the Other Threats Control condition, participants looked at photographs depicting people brandishing guns, most of which were aimed directly at perceivers. In the No Threat Control condition, participants looked at photographs depicting household furniture. Participants were asked to look at each photograph for approximately 5 s, and were instructed to attend closely to each photograph.

In the second sample, 106 participants (73 women, 33 men) recalled and described specific kinds of experiences, which differed across 3 experimental conditions (this manipulation was previously used by Murray & Schaller, 2012). In the Disease Threat condition, participants recollected a time when they felt vulnerable to infectious disease. In the Other Threats Control condition, participants recollected a time when they feared for their physical safety. In the No Threat Control condition, participants recollected the activities that they had engaged in during the previous day. In all three experimental conditions, experimenters elicited detailed descriptions by prompting participants with questions from a common list (e.g. "What emotions were you feeling during this situation?"). All participants spent approximately 3 to 5 min engaged in detailed recollection and description of the specific experience.

Before combining data across the samples, we conducted preliminary Analyses of Variance on the primary outcome measures. These ANOVAs included the two different samples as a factor (along with experimental condition and participant sex). Results revealed no main effects or interaction effects associated with the two different samples (all p's > .13). Thus, in addition to the conceptual and statistical rationales for combining data across the two versions of the manipulation, there also emerged no compelling empirical basis to treat the two samples separately. For the primary analyses reported below, we combined results into a single dataset.

2.4. Long-term and short-term mating orientation, and Future Sexual Promiscuity

Shortly after the experimental manipulation, participants completed the revised Sociosexual Orientation Inventory (Jackson & Kirkpatrick, 2007). Ten items assessed Long Term Mating Orientation (LTMO; sample item: "I would like to have a romantic relationship that lasts forever"; Cronbach's alpha = .80). Ten additional items assessed Short-Term Mating Orientation (STMO; sample item: "I can easily imagine myself being comfortable and enjoying 'casual' sex with different partners"; Cronbach's alpha = .85). Participants responded to these items by indicating their agreement on 7-point rating scales. Higher LTMO scores indicate more positive attitudes toward long-term mating; Higher STMO scores indicate more positive attitudes toward short-term mating behavior. LTMO and STMO were negatively correlated, $r = -.37$, $p < .001$.

The revised SOI questionnaire also included an additional single item assessing behavioral inclination toward future sexual promiscuity: Participants were asked to provide a numerical answer to the question, "With how many partners do you foresee having sexual intercourse during the next five years?" Responses to this question included one extreme outlier (over 9 standard deviations higher than the mean); this value was truncated to the next highest response. (The revised SOI questionnaire also includes 3 items assessing past sexual promiscuity, and a single item assessing frequency of sexual fantasy. Given our focus on attitudes toward mating behavior in the present and future, we do not include these measures in the analyses reported below. However, past sexual promiscuity was negatively correlated with Germ Aversion among women, $r = -.30$, $p < .001$; this effect was weaker among men, $r = -.16$, $p = .097$).

3. Results

Table 1 shows means and standard deviations for the three primary dependent measures in each condition, for both men and women. Consistent with previous research (Murray & Schaller, 2012), preliminary analyses revealed no meaningful differences between the two control conditions on the primary dependent variables, either for the entire sample or for males and female separately (t's < 1.44, p's > .15). Therefore, in order to simplify further analyses, we combined the two control conditions into a single Combined Control condition.

Results on LTMO, STMO, and Future Sexual Promiscuity were analyzed with 3 separate regression analyses, the results of which are summarized in Table 2. Each regression analysis included 6

Table 1
Means (and standard deviations) on attitudes pertaining to promiscuity, broken down by experimental condition and by participant sex.

Dependent variable	Experimental condition					
	Disease Threat		Other Threats Control		Neutral Control	
	Male	Female	Male	Female	Male	Female
Short-term mating orientation	4.31 (1.37)	2.98 (1.69)	4.22 (1.57)	2.86 (1.29)	4.15 (1.81)	2.87 (1.55)
Sexual partners foreseen in next 5 years	3.78 (5.26)	2.29 (5.08)	2.62 (2.47)	1.74 (1.69)	1.77 (2.36)	1.73 (2.03)
Long-term mating orientation	5.65 (0.90)	5.93 (0.97)	5.82 (0.91)	6.00 (0.68)	5.88 (0.80)	5.84 (0.95)
n	43	108	32	89	38	101

Table 2
Results of multiple regression analyses assessing the extent to which sociosexual attitudes are predicted by PVD-Germ Aversion, Experimental Condition, and Sex.

Predictor variables	Dependent variables					
	Short-term mating orientation		Future sexual promiscuity		Long-Term Mating Orientation	
	β	p	β	p	β	p
PVD-germ aversion	−.19	.001	−.15	.008	.10	.09
Experimental condition	.03	.53	.17	.002	−.05	.37
Sex	−.35	<.001	−.19	<.001	.09	.09
PVD-Germ Aversion × experimental condition	−.09	.06	−.12	.02	.10	.04
PVD-germ aversion × sex	−.06	.24	.01	.81	.00	.96
Experimental condition × sex	−.01	.91	−.14	.02	.06	.26

predictor variables: Chronic germ aversion (participant's score on the PVD-GA subscale); experimental condition (the Disease Threat condition was coded as 1, and the Combined Control condition was coded as −1); participant sex (female was coded as 1 and male was coded as −1), and 3 variables representing each of the 2-way interactions. (Three preliminary analyses also included an additional predictor variable representing the 3-way interaction between PVD-GA, experimental condition, and sex. Results revealed no significant 3-way interaction on any of the outcome variables [β's < .07, p's > .21]; therefore, the three-way interaction term was dropped from analyses reported in Table 2).

Participant sex was a significant predictor of STMO and Future Sexual Promiscuity, indicating that women were less inclined toward short-term mating and preferred relatively fewer future sexual partners. Sex did not significantly predict LTMO, $p = .09$. Of greater conceptual interest, PVD-GA was significantly inversely related to STMO and Future Sexual Promiscuity: More highly germ-averse individuals had lower STMO scores and desired fewer future sexual partners. The relation between PVD-GA and LTMO was nonsignificant ($p = .09$).

The experimental manipulation had a main effect only on future sexual promiscuity. Surprisingly, participants in the Disease Threat condition indicated a preference for relatively more future sexual partners (2.46 vs. 1.85, $p = .03$). However, this main effect was qualified by a 2-way interaction between Experimental Condition and Sex. Follow-up analyses revealed that this unexpected effect of the experimental manipulation emerged only among men: Men indicated a preference for more future sexual partners in the Disease Threat condition compared to the Combined Control condition (3.79 vs. 2.15, $p = .03$); among women, no such effect occurred (M's were 1.96 and 1.73 in the Disease Threat and Combined Control conditions, respectively, $p = .38$).

Two-way interactions between PVD-GA and Experimental Condition emerged on all three measures of sociosexual attitudes (p's $\leqslant .06$). (To ascertain whether these 2-way interaction effects might be specific to just one version of the experimental manipulation, we conducted follow-up regression analyses in which we included a predictor variable representing the 3-way interaction between PVD-GA, experimental condition, and sample. On none of the 3 outcome measures was the 3-way interaction significant, p's > .45. The PVD-GA × Experimental Condition interactions do not appear to be qualified by procedural differences in the experimental manipulation.) To illuminate the nature of these 2-way interactions, we examined the predictive effects of PVD-GA within the Disease Threat and Combined Control conditions separately. These correlations are summarized at the top of Table 3. The negative relation between PVD-GA and STMO was evident across both conditions, but was stronger in the Disease Threat condition. Furthermore, only in the Disease Threat condition did PVD-GA negatively predict future sexual promiscuity and positively predict LTMO.

As noted above, these 2-way interactions were *not* qualified by any statistically significant 3-way interactions involving participant sex. However, while there is no compelling basis to conclude that observed effects were stronger for one sex than another, the absence of significant 3-way interactions also does not logically imply that the effects were equivalent across sexes. It is potentially informative to examine within-condition correlations for men and women separately. These correlations are presented in Table 3. Among women, PVD-GA significantly predicted all three dependent variables in the Disease Threat condition (the effect on LTMO was somewhat weaker than the effects on STMO and Future Sexual Promiscuity), and for all three dependent variables this effect was stronger than in the Combined Control condition. Among men, only weak (statistically nonsignificant) correlations emerged, even in the Disease Threat condition. These results imply that the effects found in the full sample are attributable primarily to female responses.

4. Discussion

These findings make at least two novel conceptual contributions. First, these results usefully extend previous findings linking individual differences in germ aversion to overall mating orientation (Duncan et al., 2009). Whereas previous research failed to address the conceptual distinction between short-term and long-term mating, these new results reveal that germ aversion influences attitudes regarding *both* long-term and short-term mating relationships, with additional implications for future sexual promiscuity. Second, these results reveal that these predictive effects of chronic germ aversion emerge more strongly under conditions in which the threat posed by infectious diseases is perceptually

Table 3
Correlations between PVD-germ aversion and measures of sociosexual attitudes, separately within the Disease Threat condition and the Combined Control condition.

	Dependent variables					
	Short-term mating orientation		Future sexual promiscuity		Long-term mating orientation	
	r	*p*	*r*	*p*	*r*	*p*
Full Sample (*n* = 411)						
Disease Threat (*n* = 151)	−.31	<.001	−.21	.008	.20	.01
Combined Control (*n* = 260)	−.17	.006	−.05	.41	.00	.96
Women (*n* = 298)						
Disease Threat (*n* = 108)	−.37	<.001	−.34	<.001	.25	.01
Combined Control (*n* = 190)	−.17	.02	−.02	.83	−.03	.64
Men (*n* = 113)						
Disease Threat (*n* = 43)	−.20	.19	−.10	.53	.06	.72
Combined Control (*n* = 70)	−.05	.67	−.10	.41	.08	.53

salient. These moderating effects of disease salience cannot be attributed to anxiety or fearfulness in general; when conceptually distinct disease-irrelevant threats were made salient, the predictive effects of germ aversion on sociosexual attitudes were no different than those observed in an affectively neutral control condition.

It is also worth noting that these effects emerged clearly only among women. This statement should not be misinterpreted. These results alone cannot compel any confident conclusion about sex differences in the effects of germ aversion on sociosexual attitudes. But these results do suggest that inferences about relations between germ aversion and sociosexual attitudes might best be limited to the one sex within which those relations clearly emerge.

This sex-specific conclusion is conceptually consistent with previous research linking ecological context to cross-cultural differences in mating orientation: Worldwide ecological variation in pathogen prevalence is negatively correlated with sociosexually "unrestricted" attitudes, but it was only for female attitudes this correlation clearly emerged (Schaller & Murray, 2008). There are many plausible causal mechanisms that can produce population-level outcomes such as these (Schaller & Murray, 2011). The fact that we observed a conceptually similar pattern of results in our current study suggests the possibility that the worldwide cross-cultural differences may result, in part, from processes operating primarily at a psychological level of analysis.

Future research might also consider the epidemiological implications of our results. The spread of sexually-transmitted infections depends on the geometric properties of the social networks through which those infections are transmitted, and these network properties depend on individuals' decisions to have, or not have, sexual relations with specific individuals. To the extent that subjective concerns with pathogen transmission influence these decisions—as our results imply—there may be predictable and important implications for epidemiology and public health.

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